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LIGHTING OF LARGE ROOMS.

A brief article by Mr. Albert Scheible, on page 1443, commenting on the work of the International Congress for Indoor Hygiene at Dresden raises some very interesting questions regarding the requirements for such illumination. A set of seven rules laid down in a paper by the director of the Dresden Municipal Electric Plant, upon which Mr. Scheible makes comment, is really a very well-considered outline of the subject. The rules, without quoting them in full, are practically as follows: The illumination shall be well diffused, shall not be needlessly intense, but shall be strong enough to enable one to see well all over the room. Glare shall be avoided and there shall be no particularly bright points of light at the height of the ordinary line of vision. The lighting shall be easily turned on and off, in whole or in part, shall not pollute or overheat the air of the room, and shall be steady and safe. These rules, although presented as it were ex parte, are sound, if somewhat vague in the quantitative sense, and, as Mr. Scheible points out, their requirements are undoubtedly met much more easily by electricity than by gas. Nevertheless, the spirit of the rules can be more successfully carried out with gas than Mr. Scheible's comment would indicate. It is a curious and interesting fact, mentioned before in these columns, that the first use of indirect lighting was with gas more than seventy-five years ago, and indirect lighting by gas with the advantage of using mantle burners can be and is carried out without any particular difficulty.

The question of the darkening of the ceiling from the effect of the lamps, of which Mr. Scheible makes a well-considered point, is no exclusive perquisite of gas lighting. Blackening of the ceiling, at least in these days of mantle burners, does not depend on the deposit of soot from the illuminant, but on the currents of hot air set up, which carry the ordinary dust of the room up to and into the ceiling. Such blackening can be observed even over incandescent electric lamps placed near the ceiling, and is conspicuous above steam and hot-water radiators. The mantle gas burner is more likely to produce it than the incandescent electric lamp, other things being equal, merely because the former has a lower luminous efficiency than the latter. The lower the watts per candle, the less heat energy is set free to stir up the convection currents that do the work. The effect in gas burners is somewhat intensified by the fact that there is a strong upward draft through the chimney which in some constructions tends to localize the air currents. Quantity and steadiness of illumination can obviously be secured by either gas or electricity properly arranged. In either case, too, the lighting can be easily turned on and off, although much more conveniently by the use of electric lamps than in the case of gas. Many of the recent efforts at improvement

of gas lighting have been directed toward overcoming this inconvenience and with a considerable degree of success, particularly when electric ignition is employed. Nothing, however, can equal the facility of properly arranged group switches with incandescent lamps.

The matter of air pollution and overheating by gas is just now a much mooted question. We have several times had occasion to comment on the claims made by the advocates of gas regarding the sterilizing and ventilating value of their product. Their contentions have always seemed rather a joke to us, but it must be frankly admitted that the air pollution has in large measure dropped out of sight since the almost universal use of mantle burners in large work. Overheating is another matter, and anyone who goes into a gas-lighted room in summer wishes that the gas lamps were out of the way and electricity installed. In an assembly room properly ventilated for other purposes this effect is perhaps at the minimum, but so-called "gas arcs," or their equivalent, are very uncomfortably in evidence in warm weather, particularly if, owing to slight maladjustment of the burners, the combustion is not altogether complete. In the class of lighting under consideration, as in most others, the balance is strongly in favor of electricity as the best and most convenient illuminant, yet it is interesting to note how profoundly the competition of electricity has affected gas practice and with what ingenuity many of the objections to it have been met. Gas lighting, therefore, owes a debt of gratitude to electric lighting as a stimulus which is more often felt than expressed. It may be akin to the process of kicking one upstairs, but the elevation has been swift and effective.

RECEIVING APPARATUS FOR USE ON TRANSMISSION LINES.

The committee of the National Electric Light Association on receiving apparatus for use on transmission lines handed in a brief and quickly prepared but valuable report at the Seattle convention. The report shows that in the cases examined 80 per cent of the interruptions of service over a high-tension transmission system were due to "spilling over" at insulators, or brief disturbances of like nature. The remaining 20 per cent were attributable either to error in switching or to line failures of some kind. The large percentage of discontinuities arose, therefore, from momentary disturbances sufficiently powerful to throw the synchronous motors out of step.

The committee recommends that relays be not permitted to throw off the load too easily. Just because a relay receives a jolt, it should not be allowed to operate at once. It should hold on until the disturbance has had a chance to shake itself off, according to the committee's advice, and it is good advice, too. A central station without automatic cut-off relays is apt to be in constant fear of serious break-down by short circuits. After the cut-off relays have been installed they are apt to be set so sensitively that the fear is lest they should act. Cut-off relays that will disconnect, but will do so only when there is no alternative, give the golden mean for least anxiety. The committee also believes in more induction motors and fewer synchronous motors; or, if synchronous machines must be employed, heavy copper dampers should be placed on their poles and they should have elastically independent excitation.

The committee report does not mention the line, perhaps because the line lies outside of its immediate scope of inquiry; but the idea naturally arises that, in addition to the excellent suggestions offered by the report in regard to protective devices in the receiving apparatus, the factor of safety of voltage insulation on the line itself should also be increased, to prevent spill-overs from mild excess voltages.

COMMUTATION.

In the regular performance of its duty any and every direct-current machine (outside the homopolar class) is called upon to conjugate unfalteringly the verb "to commutate." When we think of the many thousands of direct-current machines that keep on conjugating, the wonder is that designers are able to produce such good results on such a slender basis of theory as has yet been constructed for the subject. The outline theory is, of course, simple enough and has long been known. It may be sketched in the proposition that the current through a coil, short-circuited under the brush, must be reduced to a certain minimum strength before the short-circuit is broken, if reasonably sparkless commutation is to be secured. The required reduction in current may be effected either by natural decay or by a counter emf of commutation or by a counter emf of resistance. When, however, the theory is analyzed in detail for any particular case, the complexities of practical conditions are usually so great that only empirical results can be obtained. It is only in rare cases that the required reduction in the short-circuit current can be obtained by the process of natural or senile decay, because the time allowed is too short. The current has to be killed off by the club of an artificially stimulated counter emf. In the bygone days of smooth-core armatures, the counter emf invoked was that due to cutting magnetic flux when the rocker arm was shifted appropriately. In the present day of tooth-cored armatures moderate conditions are met by a counter emf of resistance in the brush-contact resistance, while more severe conditions are met by an induced counter emf from intermediate commutating poles.

In the article by Mr. F. W. Carter, elsewhere in this issue, certain simple expressions are discussed as electrical criteria for sparklessness. It is pointed out, in effect, that when the duration of short-circuit is greater than the time-constant of the short-circuited coil sparkless commutation may be expected. Indeed, it is claimed that if the duration of short-circuit does not fall below half the time-constant of the coil the same happy result should follow. The time-constant is, however, defined in more strict and limited terms than the phrase ordinarily implies. Another form of the same proposition is that the reactance drop in the short-circuited coil circuit is less than π times the constant resistance drop in the same.

Some interesting and novel analysis is offered in the article for the effect upon sparkless commutation of a flat spot in the commutator. It is to be regretted that the analysis is couched in British units of measure. In metric terms the formulas would be much more presentable. The

use of the auxiliary coils and commutator for carrying off the spark energy, leaving current collection as the principal function of the main commutator, is a very interesting and suggestive device for turbo-generators. In this class of machines the difficulties of quiet commutation are exaggerated, by reason of the high rotative speed and the small duration of short-circuit. The same principle has been successfully applied to suppressing the sparking of vibrating contacts for induction coils, and if it were equally successful with turbo-generators, the complication of extra coils, ...nes and auxiliary commutator might be well warranted.

ELECTRICAL TERMINOLOGY.

The report of the committee on terminology at the recent National Electric Light Association convention is a valuable document which should be kept conveniently at hand by anyone who has occasion to read the current electrical literature, an injunction which obviously applies to all the readers of this journal. One by one a good many highly technical terms have crept into electrical literature. Some of them have been long well defined and are understood by everyone. Others have been freely used without any formal and generally known definition, and while many of these useful phrases are entirely comprehensible, it is an exceedingly good thing to have the whole group of those in fairly common use set down by the committee on terminology.

Its report is a brief electrical dictionary of special technical terms used in central-station work. Some of these terms, especially those relating to load-factor, needed definition badly, since they do not carry in themselves sufficient descriptive data. "Connected load-factor" is one of these terms, and even the committee report does not leave it in as clear a condition as would be desirable. As stated, the connected load-factor is the ratio of the metered output for any connected load during any given period to the output which would have been registered, due to the same apparatus connected, if all of this apparatus had been continually working at full rating. The weak point in this definition is that, although it primarily is applied to watt-hour metering, it is also permitted to apply to volt-ampere-hour readings. Between these two there may be and often is a very serious difference; and it also strikes us that it would be wise to make a clear distinction between the two cases. This might perhaps be done by referring to the watt output case as the real connected load-factor and to the volt-ampere output case as the apparent connected load-factor.

A similar uncertainty exists in the definition of the demand load-factor and the daily and yearly load-factors. A similar question rises with respect to the effective demand. This is customarily expressed in terms of real power, but in case of a heavy connected load of induction motors the kva output, affecting profoundly the whole distributing system and reacting on the generators, cannot be left out of account. Some large systems have found it necessary to deal directly with this problem of kva demand, and the question has often been raised whether it should not be seriously considered in the fixing of motor-service rates.

It would be interesting to obtain from some of the large plants operating many induction motors the data both for kw and kva loads, and we hope that this comment may reach the eyes of some plant manager who will deal with the question for the benefit of the fraternity. Sooner or later the subject must be thrashed out thoroughly. It would be particularly interesting to treat it in connection with some of the large transmission systems in which the place as well as the time of the demand has a particularly important bearing upon operating conditions. The further one gets into the discussion of this topic the more intricate it grows, and while the committee on terminology has done sterling work in straightening out some of the more obvious questions met in daily practice, there is still a wide field left for its future activities which we trust will be earnestly cultivated.

CURRENT FORMS IN THE COILS OF A SYNCHRONOUS CONVERTER.

The synchronous converter is a much used and greatly depended upon machine in the industrial distribution of energy. In a certain sense it is a relatively simple machine, receiving alternating currents and delivering a direct current. Nevertheless, the quantitative theory of the actions occurring in the armature coils is relatively very complicated. From one point of view the machine is a combined alternating-current synchronous motor and a direct-current generator. From another point of view it is a synchronously running commutator. From either standpoint the heating effects produced in the coils depend upon the positions of the coils with respect to the taps, the form of the current waves, their angle of lag with respect to the incoming voltage, and other details. The interesting oscillographic curves accompanying the article of Prof. J. H. Morecroft in this issue indicate that it is not necessary to employ a colossal converter in order to secure characteristic current forms from its armature coils. The little single-phase converter used has given rise to very typical oscillogaphs. It will be noticed, for instance, that the amplitude of the alternating current is greatest in the coils adjacent to the taps and is least in the coils midway between taps. It will also be noticed that the peaks of the unidirectional current pulsations do not co-phase with the peaks of the alternating currents.

The results reported indicate that the general behavior of dynamo-electric machinery is ordinarily more advantageously studied on small machines, or models, than on large industrial units of the same type. The models are also much more convenient to work with, as they consume relatively little power, use small flexible wires, and the chances of accident or breakdown in the tests are minimized. Of course, in particular cases and for particular investigations, a large machine may have to be tested; but in the great majority of cases a small machine is not only as good but actually better. This is especially evident in college engineering laboratories, where if large machines had to be used for study and test their cost, floor space and load power would be prohibitive, whereas with relatively small machines, or models, of the actual type, all the fundamental principles can be demonstrated qualitatively very conveniently.

INTERNATIONAL RADIOTELEGRAPHIC WEATHER BUREAU SERVICE.

The plan proposed by Prof. Willis L. Moore, chief of the United States Weather Bureau, for a radiotelegraphic ocean weather service has been approved by the International Radiotelegraphic Congress in London. The proposal was supported by the representatives of England, Germany, France and the United States. It was agreed that meteorological data should have the preference over all other messages except distress signals and that they should be sent simultaneously a few minutes after noon (Greenwich time) each day.

THE INTERNATIONAL ELECTRICAL CONGRESS.

At a meeting held in Boston on June 25 of the society representative members and of the committee on organization of the 1915 International Electrical Congress of San Francisco arrangements were completed for organizing the congress so as to assist and not conflict with the National General Engineering Congress that will be held in San Francisco in 1915. The International Electrical Congress has already been authorized by the International Electrotechnical Commission, which has recognized jurisdiction in such matters. It will be attended by representatives from electrical engineering societies and the governments of countries throughout the whole world. The committees thus far appointed have been selected by the American Institute of Electrical Engineers to obtain the proper co-operation with the American societies to insure the success of the congress. Both American and foreign societies will soon be requested to appoint delegates of their own selection to represent them in the congress itself. The preliminary details relating to the issuing of invitations, determination of dues, selection of date, etc., are being arranged by the executive committee, consisting of Dr. Charles P. Steinmetz, president; Dr. Arthur E. Kennelly, vice-president on program; Mr. C. O. Mailloux, vice-president on international relations; Mr. W. D. Weaver, vice-president on organization; Mr. Henry A. Lardner, vice-president on Pacific Coast relations; Dr. Edward B. Roosa, secretary; Mr. Preston S. Millar, treasurer and business manager.

BROOKLYN COMPANY SECTION, N. E. L. A.

The fourth annual convention of the Brooklyn Company Section of the National Electric Light Association was held at the Oriental Hotel, Manhattan Beach, on Wednesday, June 26, 1912. The afternoon session opened at 2.30 p. m., with an address by the chairman, Mr. W. J. Shugrue, after which followed the presentation of the reports of the treasurer, the membership committee, the committee on meetings and papers, the Question Box committee and the editorial committee. The following Seattle convention reports were presented in abstract: Report of the committee on progress, report of the committee on electrical apparatus, report of the committee on contract order routine, and the report of the committee on underground construction. The reading of each one of these reports was followed by a lively discussion participated in by a number of the younger members. The following officers were elected for the ensuing year: Chairman, Mr. M. H. Bennett; vice-chairman, Mr. C. E. White; secretary, Mr. H. M. Burns; treasurer, Mr. F. Hill; executive committee, Mr. H. M. Bennett, chairman, Messrs. C. Graves, John Leddy, William Yeager, H. C. Stevens, George McMullen, C. Woolsey, J. McCabe, W. Y. Vedder, J. G. Bogart, W. J. Shugrue, W. W. Freeman and W. F. Wells.

The annual dinner given by the Edison Electric Illuminating Company of Brooklyn to the members of the Brooklyn Company Section was served in the main dining-room of the Oriental Hotel at 6.30 p. m. After the dinner the section was addressed by Mr. Samuel Insull on the subject of "Three Decades of Central-Station Development." Mr. Insull reviewed the development of central-station engineering and central-station business from 1882, the date of starting the first central stations at Appleton, Wis., and in New York. It was pointed out that Mr. Edison's ideas of the early days still form the underlying principles of every central station and distribution system in existence to-day. Mr. Insull concluded by addressing the members in regard to their relations with the public. No other business offers such an opportunity to every man to assist in securing the good-will of the public, and every man should feel personally responsible for the success of the company.

Among the other speakers at the dinner were Mr. W. W. Freeman and Mr. W. F. Wells. The latter spoke on the history of the Brooklyn Edison company. The dinner was attended by over 700 members.

ELECTROLYSIS SITUATION IN CHICAGO.

Further hearings on the proposed ordinance to prevent damage to underground structures from electrolysis caused by leakage currents from the surface and elevated traction systems have been taking place before the Chicago Council committee on gas, oil and electric light. City Electrician Ray Palmer estimated that the cost of a negative booster system for the surface lines in Chicago would be $2,737,980 and added $1,600,000 for the elevated systems. He estimated the increased annual charges for the surface systems at $383,317. Mr. Ralph H. Rice, electrical engineer for the Board of Supervising Engineers Chicago Traction, explained the organization of the electrolysis committee formed under the supervision of the board. This committee is composed of nine members representing the various public utility companies interested, and an agreement was entered into not to make public any of the information or data secured. In response to the request of the city electrician to be placed in possession of the information covered by this committee, Mr. L. A. Busby, president and general counsel of the Chicago City Railway Company, replied that his company would consent if the information is to be used by the city in a spirit of co-operation. Mr. H. B. Fleming, vice-president of the Chicago City Railway Company, answered the request of one of the aldermen for information as to the use of the drainage system and quoted extracts from a paper presented before the Engineers' Society of Western Pennsylvania, stating that this system is successfully used in Pittsburgh. General Counsel W. W. Gurley read a letter from President Callery of the Pittsburgh Railways Company declaring that since the drainage system has been in use in Pittsburgh there has been little trouble from electrolysis. Mr. H. M. Wheeler, one of the engineers of the Chicago Railways Company, spoke briefly and voiced the opinion that a drainage system could be installed throughout the city at an expense of about $350,000, and, from his experience, he believes this will prevent any further damage. Vice-president E. G. Cowdery, of the People's Gas Light & Coke Company, was called as a witness and stated that his company has spent between $7,000 and $10,000 annually in locating damage to its underground system by electrolysis. He was unable, however, to furnish any information relative to the leakage of gas which could be charged to electrolytic damage. The engineers of the gas company regard the drainage system as a measure of relief but not as a complete cure or preventive. The total length of gas mains was given as approximately 3,000 miles, and that of the service pipes as between 4,000 and 5,000 miles.

All of these pipes were declared to be subject in some degree to electrolysis. Mr. Fleming stated that the electrolysis committee had made a careful study of the situation for several years past and had reached the conclusion that the drainage system is the only practicable commercial remedy. He read letters from various officials of the companies interested, confirming the conclusion that the drainage system is the proper remedy, including communications from Messrs. George Weston of the Board of Supervising Engineers, Garrett T. Seely of the Chicago Elevated Railways Company, D. W. Roper of the Commonwealth Edison Company, J. G. Wray of the Chicago Telephone Company, P. Junkersfeld of the Commonwealth Edison Company, E. B. Ellicott, representing the Sanitary District, and Dr. Allerton Cushman, representing the federal government. At the close of the meeting Mr. Palmer recommended that action of the committee be postponed until evidence could be taken in relation to the electrolytic damage done to the underground cables of the telephone company.

OPENING OF BOSTON CONVENTION, A. I. E. E.

The twenty-ninth annual convention of the American Institute of Electrical Engineers opened at Boston, Mass., on Monday, June 24, at the Hotel Somerset. Within the first half hour after the opening of the registration offices early in the afternoon, eighty delegates and guests had registered, and the inflowing tide rose rapidly throughout the remainder of the day. On Tuesday morning, when the convention was formally called to order by President Dunn, about 500 members and visitors occupied the auditorium, and from the outset it became apparent that an enthusiastic and successful week was ahead of the gathering. Despite the occurrence of the peak of a warm wave early in the week, the plans of the various committees for the comfort and entertainment of the delegates made the weather seem of secondary importance, and the program of business and pleasure was carried out practically as scheduled in the announcements of convention plans.

The registration offices and the headquarters of the entertainment committee occupied a parlor on the first floor of the hotel, a second parlor near the main entrance being devoted to the distribution of papers and information. The sessions were held in the hotel ballroom and in a smaller hall on the Newbury Street side of the building and were well attended at all times.

The opening reception was held in the main ballroom on Monday evening. In the receiving line were President Gano Dunn and Secretary F. L. Hutchinson, New York; Mr. and Mrs. C. L. Edgar, Mr. and Mrs. L. D. Gibbs, Mr. and Mrs. C. B. Davis, and Mr. F. P Valentine, Boston. Music was furnished by the Ninth Regiment band, of twenty-four pieces, and at the close of the reception dancing was enjoyed by a large number of those present.

PRESIDENT'S ADDRESS.

The business first in order at the opening session was the president's address. President Dunn pointed out that while the immediate object of engineering is a material one, engineers in accomplishing it draw from many different channels of human energy, all under an interpretation and insight that are best described as scientific. The subject matter of the older professions and their objects have changed relatively little in many centuries. The means have altered, but the ends persist. The horizon of engineering is ever growing; the humanities have been the same for ages, but the latter can never be invaded by anything which merely rearranges human relations to the material world. This last is the workshop and the throne, the glory and the limitation of the engineer, who is but beginning to see the vision of human dominion over the earth.

President Dunn showed how engineering has broadened into a great number of highly specialized life-works since the days of the military engineer barely 150 years ago. The Engineering Societies Building in New York is the headquarters of 50,000 members, and the membership in the American Institute of Electrical Engineers alone has increased sixfold during the last ten years. The increase in the variety of specialization has been almost as rapid as the increase in numbers. There are no less than twenty-seven recognized classes of engineers to-day, and a large and increasing part of the higher institutions of learning is devoted to their education. Parts of the engineering curricula are borrowed for what used to be purely classical courses. The social status of the engineer has risen to one nearly as high as that of the physician, the clergyman or the lawyer.

The speaker said he believed that the term "engineer" describes not what a man does but how he does it, and that the problem is one of method rather than one of occupation. The rise of the scientific method was traced from Thales, Aristotle and Archimedes, through Bacon and his confreres, to Newton, Faraday, Helmholtz and Kelvin. Engineering is not science, for in science there is no place for the conception of utility. President Dunn said that engineering is the handmaid of science, following after the latter in honor and affection, but doing the practical chores of life, concerned with the useful and the material, with costs and expediency. Engineering methods merely apply straight thinking to material problems for useful purposes. The engineering point of view is being recognized in many of the world's activities. The engineer is the man with the "dynamic component," and engineering is thought times action, so that only when the qualities of action are developed to approximately the same extent as the qualities of thought is an engineer at his best.

In conclusion, President Dunn pointed out the striking manner in which electrical engineering touches all the older branches of applied science and congratulated the audience upon the freedom of the electrical art from conservative restrictions which have so often hemmed in the older professions and minimized the work even of the engineer practising in long-occupied fields. Born scarcely twenty-five years ago, the youngest branch of engineering —electrical—had the opportunity of striking its roots into the richest of scientific soils, free from entangling alliances and traditions. The field it pre-empted was the Terra Nova of applied science. Under the influence of the masters whose names are recorded in the superb system of units of measurement upon which the electrical industry advances, the precision, convenience and reliability secured in this field have challenged the admiration of the world. Such precision of measurement contributes to clear thinking and renders reasoning about intricate quantities and relations possible. These units are a fluent language that gives the widest possible opportunity and range to thought. They are the epitome, the last word of the great minds of the age as to what the scientific method of thought is. Electrical engineering deals not only with single-phase motors, storage batteries, high-tension transmissions and turbo-generators, as an occupation, but it is a way of thinking, and as such is the latest scientific method of solving all kinds of practical problems involving matter and force, for the benefit of the human race.

PRESENTATION OF THE PRESIDENT-ELECT.

At the close of the address, which was received with great applause, President-elect Ralph D. Mershon was presented to the convention, following the usual custom of the Institute. Mr. Mershon received a high tribute from President Dunn for his work in the Institute and for his achievments in the field of high-tension transmission. Responding to an enthusiastic reception, the president-elect said that he hoped his former work would be an earnest of what he trusted would be accomplished in his administration. He

considered the Institute the most active and efficient electrical engineering organization in the world, and said that its success is due to the character of the men who serve in its councils and affairs with priceless ability, to friendly rivalry as to results accomplished, and to the shaping of the work so that full credit is given to all for what they perform. He emphasized the responsibility of the membership in supporting him in office, and closed with the reminder that, as the bâton of leadership had been placed in his hand, it will be the duty of the members "to sing together in time and especially in tune," as directed by their new leader.

A pleasant feature of the opening session was the presentation of the past-presidential scarf pin awarded to Prof. Dugald C. Jackson. In the absence of the former president, who is abroad, the emblem was received on his behalf by Prof. John Price Jackson, of State College, Pa.

At the conclusion of this ceremony the regular business sessions began. Mr. H. W. Buck presided over the electrochemical and electrophysical session and President Dunn occupied the chair in the high-tension transmission session.

The program for Wednesday was carried out practically as arranged, the morning being taken up by a joint meeting with the Illuminating Engineering Society. President Dunn occupied the chair until noon, Mr. V. R. Lansingh, New York, presiding during the latter portion of the meeting. The railway session took place at noon as scheduled, the chairman being President Dunn. The meeting was characterized by a spirited discussion of Mr. Samuel Insull's paper on the relation of the central station to railway electrification.

COMMITTEE MEETINGS.

The committee on standards and the United States national committee of the International Electrotechnical Commission held meetings on Monday afternoon and discussed the rating of machinery and the adoption of an international copper wire table. Mr. C. O. Mailloux, New York, presided at the meeting of the former and Dr. A. E. Kennelly, Cambridge, Mass., occupied the chair in the latter meeting. A reference to the work of the committee on organization of the International Electrical Congress appears elsewhere in this issue.

On Wednesday evening a meeting of Institute officers and section delegates was held in the main auditorium. President Dunn called the meeting to order and introduced Mr. P. M. Lincoln, Pittsburgh, as chairman. Among the topics discussed were co-operation with other engineering organizations, preparation of papers, tendency of technical papers and meetings to multiply, avoidance of overlap in local work, creation of large general interest in section meetings and the securing of increased breadth of national representation in the election of Institute officers. The importance of encouraging a larger attendance at conventions and general meetings was also considered in relation to the selection of officers representing all sections of the country.

Six hundred and sixty-one delegates and guests were registered by Wednesday evening.

ENTERTAINMENT FEATURES.

A large part of Tuesday was occupied by the ladies attending the convention in a steamer trip down Boston Harbor. Special electric cars provided by the Boston Elevated Railway Company left the Back Bay at 9:45 a. m. and carried the party to Rowe's Wharf, whence the steamer *South Shore* made the run down the harbor to Nantasket Beach. Upon landing, the ladies were conducted to the Atlantic House, where dinner was served. At 3:30 p. m. the boat left Nantasket Beach for South Boston, where it was boarded by a party composed of those who had accepted the invitations of the Boston Elevated Railway Company and the Edison Electric Illuminating Company of Boston to visit the two large turbo-generating stations operated by these organizations. A handsome booklet describing the principal power plants and substations in the greater Boston district was distributed to the delegates, the author being Mr. L. L. Elden, of the Boston Edison company. The party visiting the power plants on the harbor front left the hotel at 2 p. m. and were conveyed to South Boston in special electric cars. At the close of the inspection the combined parties enjoyed a trip of one and one-half hours around the harbor and returned to the hotel by special cars which met the boat. The evening was devoted to a "Pop" concert by the Boston Symphony Orchestra at Symphony Hall, complimentary tickets being given to all in attendance at the convention.

Wednesday morning was free from entertainment features, but through the courtesy of the entertainment committee taxicabs and automobiles were furnished for persons desiring to go shopping and sightseeing in the Greater Boston district.

A large party of delegates and ladies attending the convention enjoyed a trip by special cars on Wednesday afternoon to Harvard University. Upon arrival at Harvard Square, Cambridge, guides under the direction of Prof. H. E. Clifford conducted the party through the various departments of the university of electrical and general interest, including the principal laboratories and museums, the famous Yard and many points of historic attraction. The return trip was made through the new Cambridge Subway to Park Street, Boston, whence surface cars returned to the Hotel Somerset. The party visiting the Massachusetts Institute of Technology was transported to the Institute in special electric cars, a rendezvous being arranged at the Rogers Building. From this point a tour of the various laboratories, classrooms, libraries and lecture halls was made under the general direction of Prof. Harold Pender. Arrangements were made to facilitate visiting both institutions on the same afternoon. A large number of ladies made the trip to Harvard University and displayed special interest in the exhibit of glass flowers shown in the Peabody Museum. In the evening a large party of ladies and delegates enjoyed the vaudeville performance at Keith's Theater. The entertainment program for Thursday centered in an all-day trip, about 200 ladies in forty automobiles riding from Boston through Lexington and Concord over the famous "Minuteman" route, the destination being the Vesper Country Club on Tyng's Island in the Merrimack River, near Lowell. Other features of the entertainment program included a trip to the Lynn works of the General Electric Company, golf privileges at the various country clubs in the Boston district, attendance at the National League Boston baseball game between Boston and Brooklyn and the official Institute banquet, which was held on Thursday evening.

MICHIGAN ELECTRICAL CONVENTION CRUISE.

For several years the conventions of the Michigan Electrical Association, now the state section of the National Electric Light Association, have taken the form of outing cruises on the Great Lakes, the sessions being held on board vessels chartered for the occasion. This year the five-day cruise of the 209-ft. steamship *Majestic*, with the convention aboard, extended from Port Huron, through Lake Huron and the Thirty Thousand Islands of Georgian Bay, to Sault Ste. Marie and Mackinac Island, returning to Port Huron Tuesday, June 25. The regular sessions were held in the glass-inclosed sun parlor of the upper deck, affording those taking part in the meetings an unobstructed view of the scenic attractions outside.

In his official address at the opening session of Friday afternoon, June 21, President R. W. Hemphill, of Ann Arbor, congratulated the organization on its recent accession to section membership in the national association, as well as its own gain in members during the past year, which he attributed in part to the efforts of a special membership

representative whose salary and expenses are generously defrayed by the Detroit Edison Company. President Hemphill commented upon the arduous and unselfish work of the officers and committees of the association and recommended payment for the secretary's services, as well as the traveling expenses of committees. In the State of Michigan, said the speaker, there are now 291 central stations, serving 2,500,000 people. The municipalities own 123 plants, seventeen of which do street lighting only. In Michigan the policy toward municipal plants is subject to ebb and flow, but the present tendency is apparently toward the elimination of small municipal stations and the combination of small private central stations into great systems. In closing, the speaker admonished plant managers to seek especially to increase the efficiency of their operating forces, that the present high efficiency figures afforded by mechanical equipment may be duplicated. Secretary Herbert Silvester, Detroit, announced the sending of a telegram of congratulation to the Canadian Electrical Association, in session at Ottawa.

In discussing the work of the committee on rates, Mr. J. A. Cavanaugh, Benton Harbor, told of the discrepancies observed in the reports received from member companies that had been asked to make out bills under their own schedules, from sample customers' readings. Mr. J. V. Oxtoby, Detroit, explained the powers of the Michigan commission to compel the filing of rates and the keeping of uniform sets of accounts, although these requirements have not heretofore been insisted upon. The function of the commission's rate committee, he said, contemplates only the arrangement of an acceptable form of blank on which the commission's reports can be made out. The effect of such filing of rates, he added, will doubtless call the attention of companies to the complexity of their own schedules, besides working for greater uniformity of rates.

CONTRACT ROUTINE.

Mr. Roy T. Duncan's paper on "Contract Routine" outlined the plan adopted by the Detroit Edison Company in routing work orders for customers' connections. The paper was read by Secretary Silvester in Mr. Duncan's absence. As the business of an electric-service company develops, wrote Mr. Duncan, the great importance of prompt service is apt to be lost sight of. Establishing service as early as possible after securing an order not only means starting the revenue early but also building up an appreciative sentiment with the public. In small companies it is comparatively easy to keep track of orders that should have prompt or special attention, but as the business grows some system which will take care of the work automatically becomes imperative. A small company can well afford to establish a system with sufficient flexibility to expand with growing business, even though it may be somewhat cumbersome when but few orders are handled. All work-order copies, advised the speaker, should be furnished in duplicate to the department concerned, the foreman giving one to the workman and retaining the other for his own file, while the original is retained in the sales department's file.

In the discussion Mr. Silvester said that the Detroit Company formerly required customers to deposit the amount of two months' bills, but, finding the cost of the interest to be greater than that occasioned by loss on bad accounts, it is now refunding its deposits when two years' good record has been established. Deposits are still required from special classes, such as saloons, barber shops, moving-picture shows, etc., but wherever possible necessity of deposits is waived and credit extended. Mr. H. A. Fee, Adrian, recounted how, in order to avoid any appearance of discriminating, his company had required a residence deposit from a customer whose factory pays the central station $3,600 yearly. While this rule has been rigidly adhered to in the past, Mr. Fee remarked that he thought a change in policy desirable. Mr. T. L. Hinks, Mount Clemens, said that formerly local landlords were required to make good the losses sustained through their temporary tenants in business places, but this proved so embarrassing to the company in annoying good friends and permanent customers that cash deposits are now required directly from the tenants before service is begun. Mr. R. W. Hemphill, Ann Arbor, said that the majority of the large companies are now showing a disposition to take reasonable risks in the extension of credit. Mr. D. B. South, Detroit, insisted that central stations can afford to take all residence business without deposits, since 95 per cent of such consumers pay their bills regularly. On the other hand, the matter of the deposit holds up many prospective customers, decreasing the possible volume of business. Going further, Mr. H. C. Sterling, Three Rivers, recommended that all business might well be taken without deposits, and described his own plan of scrutinizing new customers for several months and keeping a blacklist on which the names of defaulting customers are entered for future protection.

LEGAL DECISIONS AFFECTING UTILITIES.

Mr. James V. Oxtoby, attorney for the Detroit Edison Company, presented on Saturday morning his paper on the topic of "Recent Legal Decisions Relating to Public Utility Companies." Two questions suggest themselves, said Mr. Oxtoby, in considering the status of outstanding contracts when the rates of charge fixed by such contracts are being investigated: (1) Do outstanding contracts which provide for certain rates unjustly discriminate against a later customer who is charged a higher rate under a new schedule put in force by the company? (2) Are such outstanding contracts binding, or may they be set aside by a commission when it undertakes to regulate rates?

The first question was considered in 1910 by the Michigan Supreme Court, in the case of Bradford versus the Citizens' Telephone Company. Both the Circuit Court and the Supreme Court held that the complainant (who was a new subscriber) was entitled to service at the rate charged old subscribers, and that the rate which the company was undertaking to charge new subscribers was discriminatory. If the company had merely undertaken to perform its existing contracts, and before raising the rates had not sought to increase the number of such contracts, and had not held itself out as ready and willing to continue to give service to its old subscribers at the old rates (even under new-term contracts), doubtless the court would have reached a different conclusion. The decision on its face suggests that the existence of term contracts constitutes discrimination against new subscribers, who are charged higher rates. But when read in connection with the record the decision does not go so far. In Mr. Oxtoby's opinion the existence of contracts giving rates to customers which if made general and perpetual would result in making all rates unreasonably low should not be taken as the test of a reasonable rate, nor considered as an undue discrimination, if it appears that the company is in good faith seeking to avoid discrimination and is merely fulfilling its existing contracts. Special rates, if offered to all customers under the same circumstances, are not subject to criticism on the ground of unjust discrimination. Very frequently such rates are experimental. It may develop that they are too low, in which case they will not be continued. If they are clearly discriminating they should be canceled or other customers of the same class should receive the same rate. However, a special rate given to a customer in one business does not actually damage one in another line. For example, a sausage maker is not damaged because a bookbinder or an automobile manufacturer receives a lower rate for electric energy than he. Both should have the same rate if they are using the same quantity of energy, under the same conditions and for the same hours, but the fact remains that unless the company raises its rate to the one to make up for its low rate to the other the former is not actually damaged.

Any rate, special or general, which is less than cost is against public policy, since its tendency is to cripple the ability of the company to serve the community properly. A special rate is an excrescence to be got rid of as soon as possible and not multiplied or fostered.

Contracts made by a public utility may be subject to voidance by the rate-regulating power of the state, the parties contracting with reference to this fact. This is the view of the New York Public Service Commission, First District, as declared in its decision of April 10, 1912, in the Bridge Operating Company rates case. The contract in this case was not apparently a franchise, but a mere operating agreement. The Bridge Operating Company has since taken the matter into the courts.

The Railroad Commission of Wisconsin, where no questions of unjust discriminations are involved and where the business cannot be had on better terms, usually takes the position that it is better for all concerned to keep business that will yield something in the way of returns for interest and profit rather than not to have it at all.

There is no doubt of the right of a public-service company to transmit electricity beyond the state and thereby engage in interstate commerce. The United States Supreme Court held this in the case of Haskell versus the Kansas Natural Gas Company, affirmed on rehearing April 1, 1912.

If the Interstate Commerce Commission may require uniform accounts, which will show all the business of a carrier, state, interstate, and joint rail and water, for the purpose of enabling it to inform itself as to the interstate commerce over which only it has jurisdiction, then it must be equally true that a state commission has authority to require carriers to make reports covering both state and interstate business to enable the commission to inform itself as to the state business of the carrier.

A case of much interest to those hereafter incorporating public utility companies under the laws of foreign states for the purpose of doing business in Michigan is that of the Peninsular Power Company, incorporated May 9, 1911, under the laws of Wisconsin, for the purpose of acquiring lands in Michigan and Wisconsin on the Menominee River. The company applied for a license to do business in Michigan, which was refused by the Secretary of State until it had obtained the approval by the Michigan Railroad Commission of its original issue of stock.

Hereafter, said Mr. Oxtoby in closing, when a public utility company proposes to do business in another state besides Michigan it will have to make simultaneous applications in both states for the approval of its securities, in order to avoid the embarrassing situation in which the Peninsular company found itself.

In opening the discussion on his paper, Mr. Oxtoby read a recent decision of the Michigan commission in the Cassopolis telephone case, in which the commission held that the requirement of certain customers to sign contracts, while others had no contracts, was discriminatory and should be prohibited. While admitting the right of the company to reasonable regulations for its business, the commission held that these once instituted must be generally enforced and no privileged exclusions granted at the corporation's caprice. The commission also ruled that since the cost of the initial installation represents a large part of the profit from the first year's service of a utility it is reasonable that a customer requiring service for only a short period should pay a rate higher than the annual schedule.

Mr. F. B. Drees, Lansing, pointed out the advisability of operating combination small-plant businesses under separate companies to avoid commission supervision of non-utility departments, thus separating such businesses as milling, ice-making, etc., from the electrical plant, which could charge for its energy at a reasonable rate, collectible from the associated corporation. Mr. R. W. Hemphill, Ann Arbor, made a similar point in connection with wiring and contracting businesses operated by central stations. In reply to an inquiry by Mr. D. B. South, of Detroit, Mr. Oxtoby declared that court opinions can be found both confirming and denying the legality of meter rentals. The Doherty rate he cited has as a base the consumer charge, the elements of which cover the installation and meter costs.

In answering a comment that commission regulation might result in uniform rates in Michigan and the overlooking of local differences in production costs, Mr. Oxtoby pointed out that after years of regulation in Massachusetts rates there are still about as diverse as elsewhere, the functions of the commission being confined to seeing that adequate service is supplied for customers at fair rates and without discrimination. In reply to a question by Mr. J. E. Stanton, Belding, asking the legality of a franchise rate schedule which requires meters for business houses and flat rates for residences, the attorney explained that any rate mutually agreed upon by the common council and the company is to be considered legal.

FACTORS IN EARNING ABILITY.

In his paper on "Load-Factor, Diversity-Factor and Power-Factor, and Their Effect on Small Central Stations," Mr. Calvert M. Wardwell, of Ann Arbor, showed by numerical examples how the revenue of a given system depends on the kind of apparatus connected, its electrical characteristics and the hours during which it is used. Mr. Wardwell's lesson was directed particularly at the smaller central stations, which, he advised, should follow the examples of the larger systems in giving attention to these vital factors which absolutely control the earning power of every dollar invested. The paper was illustrated with curves showing the effect of load-factor on fixed and operating costs per kilowatt-hour. In conclusion, Mr. Wardwell said: (1) Load-factor controls revenue. (2) The higher the load-factor, the greater the revenue of capital invested. (3) Good power-factor allows the use of the full rated output of our generators, line and transformers and consequently increases the revenue. (4) Diversity-factor controls the station investment. (5) These three factors absolutely control the earning ability of every dollar invested.

In the discussion of Mr. Wardwell's paper Mr. R. S. Stewart, Detroit, remarked that while the business of many small short-hour users is looked upon as undesirable, the diversity between their individual demands may make the resulting load equivalent to that of a single large customer having a good load-factor. Mr. J. A. Cavanaugh, Benton Harbor, made the objections that the demands of most short-hour users come at the peak, when they may be supplied with energy at a positive loss to the plant. Mr. H. Silvester, Detroit, illustrated how the Detroit railway peak occurs between the factory motor peak and the residence-lighting peak. Mr. G. D. Slaymaker, Rochester, cited an instance where a factory was induced to install a 150-kw synchronous condenser, the running losses of which are rebated by the central station, which profits from the improved power-factor obtained.

ENERGY-CONSUMING DEVICES.

"Some New Energy-Consuming Devices of Interest to Central Stations," the paper presented by Mr. A. B. Hoffman, of the Wagner Electric Manufacturing Company, St. Louis, Mo., described applications of the new single-phase rotary converter and battery-charging mechanical rectifier recently developed by that company and already described in these columns. The paper was discussed briefly by Messrs. H. C. Sterling, Three Rivers; R. W. Hemphill, Ann Arbor, and R. S. Stewart, Detroit.

SERVICE IN RURAL DISTRICTS.

In his paper, "Central-Station Service in Rural Districts," Mr. George D. Slaymaker, Rochester, gave data

on the farm service supplied by the 4600-volt, three-phase tie lines of the Eastern Michigan Edison Company, which now reach twenty-five towns. The original lines were constructed to connect urban communities, but 50 miles of farm lines have since been added, the company installing transformers, meters and service wires free of charge. Any plan to make the farm customer pay part of the investment charge, declared Mr. Slaymaker, will mean little country business, loss of farmers' good-will and, eventually, bickerings over ownership. Charging special high rates for farmers, on the other hand, means discrimination; but the policy of treating farm business as incidental to interurban transmission lines results practically in "velvet," said the speaker, returning a good revenue per kw-hour for energy taken at a high load-factor. Under the last plan, the Eastern Michigan Company, declared Mr. Slaymaker, finds the farm business profitable and expects a great future. For four lines from which farm service is supplied, the author gave the following figures:

Line.	A.	B.	C.	D.
Average number lighting meters per mile	4	3	8	5
Average number motor-service meters per mile	2	0	2	2
Average units per lighting meter per month	16	21	27.8	55.5
Average units per motor-service meter per month	82	.....	54	92.7
Average revenue per lighting meter per month	$1.20	$1.37	$1.73	$3.08
Average revenue per motor-service meter per month	$5.17	.....	$3.98	$4.86

All the farmers on one of these lines now use electricity for lighting, and 25 per cent also use it for motor service. Customers are being added very fast, owing to the fact that farms of from two to five acres are in great demand in that section. An increase in customers of 75 per cent in a year would not be an extravagant estimate. Moreover, it seems probable that every farmer will shortly be meeting all of his motor-service requirements with electricity.

Mr. Slaymaker also recounted the instance of a farmer whose minimum bill for a 5-hp three-phase motor was $4.75 a month. At his rate of 4 cents per kw-hr., the customer realized that he was entitled to 119 kw-hr. and, proposing to get his money's worth, studied his meter and energy consumption in order to plan his motor-service processes to utilize the waste minimum. As a result he has for two years managed to do practically all of his motor work at an average cost of $5.48 per month, his maximum bill being $8.28. Moreover, by doing custom feed grinding and ensilage cutting for his neighbors he has earned enough by his motor to pay a large part of his lighting and motor-service bills. His motor cost him about $75 installed and his old gasoline engine about $150.

BOILER-ROOM ECONOMY.

In his paper on "Boiler-Room Economy" Mr. Norman Reinicker, Detroit, significantly pointed out that since fuel cost makes up about half of the total production expense boiler-operating methods should receive the closest attention from small as well as large plants. The author advised steaming tests, preferably for long periods, to determine the most economical boiler arrangements for furnishing partial station loads. After a discussion of the chemistry of combustion, Mr. Reinicker pointed out the value of carbon-dioxide-analysis apparatus, when properly attended to, for giving an accurate diagnosis of furnace conditions in place of unreliable judgment on the appearance of the fire. Steam-flow meters enable boiler loads to be read directly and to be properly proportioned among the units of a battery. The operations of dumping, opening doors, stirring fire, etc., effect in a surprising degree the rate of steaming.

In closing, the author suggested the analysis of coal from various parts of a given carload, to determine its steaming ability, also recommending the purchase of the fuel on the basis of its heat-unit contents. Mr. Reinicker illustrated his discussion with a practical apparatus.

STREET LIGHTING

"Street Lighting" was the subject of a paper by Mr. D. M. Diggs, of the General Electric Company, Schenectady, N. Y., in which, after tracing the history of the art from the first pitch lanterns in the fourteenth century down to modern incandescent and luminous-arc illuminants, he showed distribution curves of commercial lamps and illustrated their application in practical street-lighting problems. The particular desirability of each illuminant was pointed out for such uses as lighting business, secondary and residence streets, parks, etc., the author making the point that where possible single high-efficiency arc-lamp units should be chosen in place of groups of less economical and smaller light sources. Details of the inverted New Haven type of magnetite-arc lamp mounting were discussed in full, the paper closing with an interesting prophecy concerning the perfectly lighted city of the future. Mr. Diggs' remarks were illustrated with a collection of forty lantern slides, showing installations, lamps, etc.

SMALL-PLANT OPERATION.

"Some Experiences in Operating Small Plants" was the title of a paper by Mr. Robert S. Stewart, of Detroit, in which, after setting forth the conditions all too likely to prevail in the average small station, he recounted how a new management had effected changes and economies which permitted a substantial reduction in rates with twenty-hour service, and although the gross income has increased 60 per cent, the equipment of the plant and its maximum load still remained the same as before. Competition from other light sources is meanwhile practically eliminated, all local stores have been made users of electric light, and the community now boasts one electric customer to every eight inhabitants. While the physical value of the plant was not increased greatly, its real valuation, based on service to the community, was much augmented. This increase, added Mr. Stewart, was not due to special conditions or engineering work, but simply to the application of common sense. "What the small town needs is not an engineer who will install a plant of the highest efficiency, but one who will use common sense, so arranging his plant as to obtain the greatest possible revenue without increasing expenses to a prohibitive point."

OFFICERS.

Accepting the report of the nominating committee, the association elected the following officers for 1912: President, Mr. F. B. Drees, Lansing; vice-president, Mr. H. C. Sterling, Three Rivers; secretary, Mr. Herbert Silvester, Detroit; executive committee, Messrs. A. C. Marshall, Detroit; H. A. Fee, Adrian; R. W. Hemphill, Ann Arbor; F. B. Spencer, Cheboygan, and Thomas Chandler.

ENTERTAINMENT.

Bright blue weather marked the special trip of the *Majestic*, whose 110 convention passengers were treated to an ever-changing panorama of land and water, with visits ashore at various points of interest. Reaching Penetanguishene, Ontario, Saturday afternoon, after a twenty-four-hour run through Lake Huron and Georgian Bay, the party was transferred to a steamer of lesser draft, the *Waubic*, for the trip among the Thirty Thousand Islands to Parry Sound. Here supper was served at the Hotel Belvedere, followed by dancing and a moving-picture entertainment. Rejoining the *Majestic*, which had proceeded to Parry Sound by the outer course, the convention crowd then embarked for the "Soo," reached through the beautiful St. Mary's River next day. After spending Sunday evening at the "Soo," the *Majestic* weighed anchor for Mackinac Island. Seven hours were spent in inspecting this beauty spot before the return journey was begun, landing the voyagers at Port Huron Tuesday afternoon.

CONVENTION OF CANADIAN ELECTRICAL ASSOCIATION.

The Canadian Electrical Association held its twenty-second annual convention in the city of Ottawa, on June 19, 20 and 21, 1912, in the Château Laurier. On Wednesday, June 19, Mayor Hinckey of Ottawa delivered the address of welcome, which was responded to by President A. A. Dion.

In his presidential address Mr. Dion said that during the past year the membership has increased to a considerable extent, although perhaps not so much as had been expected. There are now company sections in Toronto, Montreal, Ottawa, Hamilton and Vancouver. He stated that as he had been president three times, he should retire and give the younger men a chance with their new plans and ambitions to advance the usefulness of the association.

The report of Secretary-treasurer T. S. Young showed that the association had progressed during the past year. At the conclusion of his presentation of the report, Mr. Young resigned from the office of secretary-treasurer on account of pressure of work. It was moved by Mr. Frederick Nicholls that the association should express its appreciation of Mr. Young's services by presenting to him an illuminated address. On a standing vote being taken the motion was declared carried. Subsequently Mr. Young was elected honorary secretary.

Mr. L. V. Webber read the report of the meter committee, giving a summary of what had taken place with respect to the production of meters in Canada. He expressed the opinion that probably there will be an increasing call for demand meters and indicators. A combined watt-hour and demand meter is now obtainable which will probably prove useful to those who wish to install it. It is of great importance, he said, especially in wholesaling energy at high potential, to have a maximum-demand meter, as the contracts for service are generally made on the demand basis. He spoke of the various types of meters which are now obtainable and recommended the companies to purchase the meterman's handbook. Mr. A. L. Mudge, who moved the adoption of the report, expressed the belief that the watt-hour meter with a maximum-demand attachment will come into general use when the price is reduced. Mr. R. F. Pack, in discussing the report, said he thought it to be absolutely necessary that a fairly accurate and efficient meter be manufactured at a very low cost. In answer to a question, Mr. Webber stated that several companies are making watt-hour meters with demand attachments. He said that if a 25-amp meter can be produced for $40 the demand will be met.

COMMERCIAL COMMITTEE REPORT.

The report of the commercial committee, which was presented by the chairman, Mr. T. F. Kelly, dealt with replies received from thirty-four member companies to questions concerning methods of conducting their business. The majority of the companies of the association are serving territories of 10,000 people or less, yet at least ten are maintaining separate departments for the purpose of securing new business. Eighteen companies employ one or more persons actively in soliciting. Fourteen of the companies pay salaries to the solicitors while four pay only on a combined salary and commission basis. Seven companies supply the first set of carbon lamps without cost while eleven furnish new carbon lamps free when they are returned. Sixteen companies do outside wiring, and thirteen of these accept payment in instalments. Nineteen companies sell electric motors and fifteen companies accept payment upon the instalment plan.

Discussion.

The report was discussed briefly by Messrs. P. H. Kemble, D. H. McDougall, H. B. McDunnough, Wills McLachlan, and J. G. Henninger.

THE INFLUENCE OF ICE ON WATER-POWER DEVELOPMENT.

Prof. H. T. Barnes presented an interesting paper dealing with the formation of ice and with methods that can be employed to prevent this formation where it may become troublesome. He discussed separately the three distinct forms of ice formation in nature, namely, surface ice, frazil ice and anchor ice. Of these frazil ice is the most troublesome to power houses; it is the fine needle ice found floating in the open water. It is formed by surface cooling in water flowing too swiftly for surface ice to form. The current carries the ice down and under the barrier of surface ice which extends over the quieter parts of the river, and there it settles upward and becomes attached to the under side of the surface sheet. In a short time are produced immense hanging dams which impede the watercourse and cause a rise of the water level.

Professor Barnes gave the following rules for avoiding ice troubles: (1) Have covered racks and steam heat provided for the trouble which always comes to a power house before the permanent ice forms. (2) Install a few meteorological instruments to watch the weather in order to be prepared for the first cold snap. (3) Where the forebay is fed from a lake or canal induce freezing as soon as possible; otherwise maintain an open channel down to the power house. Provide a special way for the floating frazil. (4) Watch the temperature of the winter at the outset of the cold weather, and when 32 deg. Fahr. is approached have the steam-heating plant in readiness.

At the conclusion of the presentation of the written paper a number of views were thrown on the canvas illustrating some of the means which had been used in ice breaking in order to keep open water, and also the effects on the ice of sunlight, wind and rain. Some views were also shown of scenes in Russia, where this question is receiving considerable attention. In conclusion Dr. Barnes explained his experiments with a thermometer he had developed which indicates the nearness of ice in open water.

Discussion.

Mr. John Murphy opened the discussion by exhibiting on the canvas some pictures of ice formation in different localities, and also of a number of power plants where steam-heating appliances had been found to work very effectively in connection with ice racks. He also gave the result of the tests he had made of the temperature of water during the winter months.

President Dion, in commenting on the paper, said that his company had come to the conclusion some years ago that iron bars are not the best for racks, for the reason that they are good heat conductors, and therefore a very rapid transfer of heat takes place when the upper parts of the bars are exposed.

The discussion was continued for some time by a number of the members, who considered some of the points brought out exceedingly interesting. Among those taking part were Messrs. W. L. Bird, W. H. Munro, H. B. McDunnough and P. H. Kemble.

RECENT DEVELOPMENTS IN LAMPS AND REFLECTORS.

Mr. J. G. Henninger outlined briefly in chronological order the developments that have taken place in incandescent electric lamps, beginning with 1856, when the first patent was granted in the United States for an incandescent lamp having a platinum filament, and following the improvements made up to the introduction of the present high-efficiency tungsten-filament lamp. It was stated that this lamp is three times as efficient as the carbon lamp, which radiates as light energy only 0.2 per cent of the total energy obtained initially from coal used as fuel.

Among the improvements in the lighting of large industrial plants which have been made during the past year the author mentioned a large angle-steel reflector for 500-watt lamps. This reflector was designed so that the greater por-

tion of the light from the lamp is confined within a vertical angle of possibly 120 deg., while the spread horizontally is not far from 180 deg. It has been found that a very efficient system of illumination can be had when these units are placed along the sides of the shop beneath the crane rails. The author gave estimates showing that in a certain factory operating ten hours per day for 300 days per year the cost of good illumination per man amounts to $1.72 per day, or the equivalent of a man's time for 2.9 months. When this small cost is contrasted with the increased production by the workman, the reduced liability to accident and the improved quality of products, the cost of good illumination becomes practically insignificant.

Discussion.

After reading his paper Mr. Henninger illustrated his meaning by lantern views, showing where direct illumination had been replaced by indirect and semi-direct illumination with reflectors, the change appearing to be very beneficial.

Mr. H. B. McDunnough stated that the paper would be of special help to the managers of central stations in small cities, where the manager is a jack-of-all-trades, and where he has an opportunity for exercising his influence with the customers in the purchase of suitable lamps in order that the best results may be obtained.

The method used in the city of Hamilton was fully explained by Mr. T. F. Kelly, of that city, who followed in the discussion. He said that the plan of inviting manufacturers and merchants to attend lectures by prominent illuminating engineers had proved very successful.

In reply to a question by Mr. O. Higman, of Ottawa, Mr. Henninger said that he knew of only one company in America producing illuminating tubes of different lengths operated by high voltage discharge through a low-pressure gas, which gives a light very similar to daylight and is used in color matching.

Mr. P. H. Kemble suggested, in answer to a question by Mr. Wills Maclachlan as to whether anything can be done to get rid of ultra-violet in the light, that the harmful rays can be removed by dipping the lamp in a solution of potassium bichromate.

OUTLYING DISTRIBUTION SYSTEM.

Mr. S. Bingham Hood presented a paper containing a large number of data on the cost of construction and the service life of equipment used for distribution in suburban sections and isolated localities. The paper contained a table showing the investment and annual costs of poles of various types from 30 ft. to 35 ft. in height and from 6 in. to 8 in. in diameter. The estimated life of these poles was from six years for an untreated wood pole to twenty-five years for a treated, retreated and reset pole. The annual cost of the former was given as $2.05, that of the latter as $1.65.

It was claimed that the life of the microbe which caused wood rot depends upon the existence of air, light and water. The removal of any one of the three essentials to life would prevent wood rot. The part of the pole well above ground is protected from rot on account of the absence of water. A short distance below the ground line both light and air are eliminated, and hence the danger zone is confined to between a few inches above ground and from 12 in. to 18 in. below. Any compound which will permanently exclude air from this portion of the pole will prevent rot. The only really successful compounds for this purpose appear to be some of the coal-tar by-products, of which the dead oil, known to the trade as carbolineum, appears, on the whole, to be the best.

The cost of a concrete pole in position is about that of a treated cedar pole, and, theoretically, there should be no limit to its life. However, two forms of failure of these poles have been noted, one attributed to shrinkage cracks in the concrete and the other to the giving way of the reinforcement. Tubular steel poles for lengths up to 30 ft. may be set in concrete at a total cost of about $30 each. When properly installed, the life of such a pole should be at least twenty-five years, and the annual charge should be about $2.46 per year, which is about two-thirds greater than that for a wooden pole. A structural iron pole can be made and placed in position at a cost of $20, and its life should be at least twenty-five years with an annual cost of less than $2. By installing intermediate poles of the lattice-strut type, with a heavier pole at each fifth or sixth point of support, the average annual cost per pole should not exceed $1.60, or about the same as that of a wooden pole.

In discussing the selection of apparatus the author claimed that it is not necessary in many cases to introduce frequency changers where the major portion of the service calls for 25 cycles and some lighting must be done. He stated that for lighting a frequency of 60 cycles has undoubtedly some advantages, but the idea that frequencies as low as 25 cycles are impracticable for this purpose is entirely an error, provided the generator has a wave-form approximating a smooth, true, sinusoidal curve. Low-wattage metallic-filament lamps exhibit a bad flicker on frequencies below 30 cycles, but the public can easily be educated to use higher candle-power units in preference to small units. Experiments have shown that with a frequency slightly above 25 cycles the flicker defect disappears. An increase of frequency, say to about 27.5 cycles, would represent a marked improvement in this respect. Such an increase can be obtained by running standard 25-cycle apparatus at a 10 per cent increase in speed.

Discussion.

Mr. Hood's paper called forth a great deal of discussion from the members. The question of joint poles was considered by all to be a very important one, from both the economical standpoint and that of the appearance of the streets.

In commenting on the paper Mr. F. T. Stocking said that he considered the treatment of cross-arms with a good preservative and the galvanizing of hardware to be good investments.

Mr. A. L. Mudge claimed that the paper was too optimistic as to the working of 25-cycle lighting, but at 27.5 cycles the objection disappeared. He said many claims are made regarding the injury to eyes in connection with low-frequency lighting.

In closing the discussion Mr. Hood said that where there is a basement no doubt that is the proper place to bring the wires in. In connection with his reference to the transferring of the defective three-phase circuit from the bad phase to the two good ones he explained that he spoke with regard to a feeder made with three distributions, in which case it is a simple thing to cut it with a jumper. Mr. Hood stated that he had very good results with 25-cycle lighting.

WATT-HOUR METERS.

Mr. C. W. Baker read a paper in which were outlined the operating characteristics of electrolytic, commutator and induction-type watt-hour meters and electrolytic and induction ampere-hour meters. The distinguishing feature of this meter is that the shunt-circuit current and the series-circuit current are in exact time-quadratures for loads with unity power-factor. The lag of the current behind the emf is adjusted to 90 time-degrees by suitably proportioning the amount of iron constituting an interrupted magnetic core to the width of the air-gap and to the windings employed. In the typical induction meter use is made of a thin aluminum disk mounted on a short shaft to serve for the armature. With the exception of the registering device this disk is the only moving part of the meter. An essential feature of the meter is the alignment of the bearings which support the disk shaft. The upper bearing should be rugged yet flexible to absorb the vibrations of the disk and shaft without noise. A perfectly rigid upper bearing would throw a greater

amount of the vibrations on to the lower bearing and cause greater wear on the jewels and pivot. Most makers use a pivot lower bearing running in a cupped sapphire jewel. In another type use is made of a steel ball running between two cupped sapphires, while in a modified form of this bearing one cupped jewel is used and the steel ball is set in a conical recess at the bottom of the shaft.

Discussion.

In commenting on the paper Mr. H. S. Brown stated that while there are some differences of opinion among the designers with regard to some of the mechanical features, yet he thought the paper placed matters very clearly before the association. Some designers, he understood, believe in placing the worm-gear reduction mechanism at the shaft of the meter and others at the third or fourth position in the reduction. He thought the lacquering and dipping to be a good idea, but on account of being very thin on the bearings it peels off. With regard to the ball bearing, some regard it as only a theoretical advantage, it being impossible to produce a perfect sphere, and he had his doubts whether there is very much advantage in it over the pivot bearing.

Mr. A. B. Lambe, of the Inland Revenue Department, commented on the paper rather extensively, there being some points with which he did not agree, though he thought it to be a very valuable paper. He said that the Inland Revenue Department is trying to discourage the introduction of combination meters and is trying to bring about the standardization of certain parts of the meters. He is opposed, he said, to the polyphase meter for balanced circuits which comes from Europe, and he discussed at some length the design of the meter.

As a central-station man Mr. Webber thought the value of the paper could not be overestimated. He thought it was a splendid thing to hear directly from a manufacturer what is being done, and it is gratifying to see the degree to which the manufacturers have finally developed the meter. One thing that the central-station men should do is to test more closely the direct-current meter. He spoke of the results of some tests he had read of in connection with ball bearings and stated that the best result had been obtained by saturating the bearing with oil.

The president said he was glad to see that the department is trying to obtain standards along some lines. He considered this a step in the right direction. A great deal of interest was shown in Mr. R. Hornby's remarks with reference to what is being done in Europe. Mr. Baker, in replying, said that he was glad he had been able to write a paper which had called forth so much discussion and hoped it would prove of benefit to some at least.

COMMERCIAL ELECTRIC HEATING.

Interesting features relating to the commercial aspects of electric heating were given in a paper by Mr. McAllaster Moore. The author stated that to bring electricity as a heating medium to a par with coal at $5 a ton it would be necessary to sell the energy at $4.38 a horse-power year. Although this value seems to be prohibitive, yet there has proved to be a field for commercial electric heating. Perhaps the most important commercial use of electric heating is in laundry and tailor shops, where the cost of energy is not a factor of importance. The quality of the work, the speed with which it may be performed and the time saved by the operator far outweigh any question of energy cost. So far as the revenue to the central station is concerned, a rate of 3 cents per kw-hr. to a laundry is equivalent to a motor-service rate of $67.50 a horse-power year on the ten-hour day basis, with an added advantage of having 100 per cent power-factor and approximately 100 per cent load-factor.

A useful electrically heated device is the glue pot, numerous types of which are on the market. Aside from convenience and portability, however, the principal argument in favor of the electrically heated glue pot is the elimination of the fire hazard. An electrically heated sealing-wax pot has proved of great convenience to banks, express offices, etc., and the electric pitch kettle has proved similarly advantageous in brush factories and other places of this nature. Foremost among the domestic heating devices is the electric baking oven. The oven is ordinarily used between 12 at night and 6 in the morning, when all other business is practically at a standstill. The average energy consumed is 80 watt-hours for a pound loaf. Mention was made of a large electrically heated bakery in Milwaukee where the output is 500 loaves at one baking. Although it can be shown that an excessive amount of energy is required for heating water for bathing purposes, yet it may be stated that with energy sold at the rate of $30 per hp-year an apartment house containing from ten to fifteen families can be supplied with heated water at an exceedingly reasonable cost per annum.

POWER FACTOR.

In a paper called "Power-Factor, Its Influence and Value," Mr. D. H. Ross described the operating characteristics of a single-phase motor of the compensated type, which operates at unity power-factor under full-load conditions. When running idle the motor draws a leading component of current equal to about 30 per cent of the full-load current. The leading component of current falls off rapidly with increasing load and is practically zero from half load to load and a half. The author claimed that the unity-power-factor motor is highly advantageous in minimizing the installation, maintenance and metering costs as compared with polyphase induction motor installations.

Discussion.

The paper was discussed by Mr. S. B. Hood, Mr. A. A. Dion and Mr. P. H. Kemble, all agreeing that it is a subject which should be carefully investigated, as it is important both to the companies and the customers. Mr. Ross, in replying, said that a great deal of information as to the construction of the motor referred to would be found in a paper which had been read before the National Electric Light Association last summer.

NEW BUSINESS.

Methods that have proved effective in obtaining new business in Hamilton were outlined in a paper by Mr. Thomas F. Kelly. The author stated that before embarking in any particular campaign for a certain kind of business an advertising campaign should be planned and adhered to. Advertising should be conducted not only by means of the daily papers but also through the medium of electric signs, illuminated billboards, street-car cards, monthly bulletins, etc. Lighting business can be obtained by maintaining direct connection with the building inspectors' office, while motor-service business can be obtained by remaining in touch with the board of trade. In Canada lighting fixtures are installed in dwellings by the tenants and not by the property owners, as in the case of the United States. Hence the solicitors are compelled to reach the tenant in order that the proper fixtures shall be installed.

In Hamilton arrangements have been made with the sign manufacturers according to which the sign company owns and installs the electric signs. The company does all the soliciting and advertising in connection with the proposition. The agreement between the central station and the sign company is one whereby the central station collects the accounts and maintains the sign, in addition to furnishing the energy, and the sign company pays the central station for this service. The amount mentioned in the contract between the customer and the sign company is a flat rate covering the furnishing and the erection of the sign, its lighting and maintenance. The sign always remains the property of the sign company.

Discussion.

Mr. P. H. Kemble, Mr. Wills Maclachlan, Mr. R. Hornby and Mr. Marshall took part in the discussion. As to the matter of owning and maintaining signs it was thought advisable that the companies should not do this but should contract with some advertising company, keeping an oversight, however, on the condition of the signs.

OFFICERS.

The executive committee announced the election of the following officers for the year: President, Mr. R. F. Pack; first vice-president, Mr. W. L. Bird; second vice-president, Mr. R. H. Sperling; third vice-president, Mr. J. S. Norris; honorary secretary, Mr. T. S. Young; managing committee, Messrs. A. A. Dion, W. C. Hawkins, A. L. Mudge, H. G. Matthews, W. L. Adams, F. A. Chisholm, I. H. Wright, D. R. Street, P. H. Kemble, Wills Maclachlan, D. N. McDougall, E. L. Milliken, H. B. McDunnough and W. Phillips.

PUBLIC SERVICE COMMISSION NEWS.

OHIO COMMISSION.

Mr. Frank A. Davis, president of the United States Telephone Company, will make a personal report to the commission on July 8, embodying the plans of the telephone interests, according to announcements from Columbus late last week. It is believed that this will be followed by a request for the approval of a policy of property exchange that will practically eliminate the dual service throughout the State. Further, telephone men have expressed the belief that the plans are such as will meet with the favor of the commission.

MARYLAND COMMISSION.

The Maryland Public Service Commission has set July 10 as the date on which it will take up the case of the city of Baltimore against the Consolidated Gas, Electric Light & Power Company, in which a general reduction in rates is asked. The case has been pending since last year, and some months ago the company filed its answer to the complaint of the city and also filed financial statements in accordance with the request of the commission. In one statement filed the company argued that it should be permitted to earn a dividend on many millions of dollars of intangible assets. It is expected that the early part of the session will be taken up in the hearing of the opening statements of both sides. The electric company will be represented by its full array of counsel, and Mr. Albert C. Ritchie, assistant counsel of the commission, will appear as the advocate of the general public. The city government's side of the case is in the hands of Mr. Alexander Preston, assistant city solicitor.

NEW YORK COMMISSION.

The New York Public Service Commission, First District, has published Vol. I, with reports of its decisions. This volume covers the period from July 1, 1907, when the commission first took office, to Sept. 1, 1909. Vol. II will cover the opinions handed down between Sept. 1, 1909, and Jan. 1, 1912. The index digest of the contents of the first three volumes will appear at the end of Vol. III, which will contain the opinions of the commission for the year 1912. The contents of the present volume are well indexed and classified. The Public Service Commission law, which was approved on June 6, 1907, and became effective July 1 of the same year, is given in full and supplemented by the rules of practice.

The New York Public Service Commission, Second District, has recently created a division of transportation which will have charge of the inspection of the maintenance of way and operation of the steam railroads within the State, the investigation and classification of all accidents and such other special investigations or inspections as may be assigned to it. It is expected that this division will also make inspection of the interurban electric lines. Mr. C. R. Vanneman, who for the past two years has been a steam railroad inspector for the commission, was promoted to be chief of the division, and Mr. J. B. Stouder was appointed steam railroad inspector to fill the vacancy caused by the promotion of Mr. Vanneman.

The commission for the Second District has handed down an order which requires the New York Telephone Company to reduce its rates so that subscribers living in the town of Elmira in the district known as West Elmira shall be charged the same rate for telephone service as is charged in the local area in the city of Elmira. The telephone exchange is situated about 2¼ miles south of the northerly line of the city and 1⅜ miles east from the westerly boundary of the city. The hamlet of West Elmira is at a distance of about 2 miles from the telephone exchange, which is less than the distance from the northerly line of the city to the telephone exchange, but the company has been making an additional mileage charge which fixed the rate to be paid by West Elmira subscribers at $12 a year more than the rate charged within the city limits. The commission finds that the mileage charge made is unreasonable and unjustly discriminatory and that the just and reasonable charges are those now charged for like service within the territorial limits of the city of Elmira.

NEW JERSEY COMMISSION.

The Board of Public Utility Commissioners for the State of New Jersey has published its second annual report, covering the year 1911. The first twenty-five pages are devoted to a condensed summary of the commission's work during the year; then follows a full presentation of decisions, orders, memoranda and rulings adopted. The report concludes with a recital in full of the public utilities law, rules of practice and standards for gas service.

WISCONSIN COMMISSION.

In the case of the Calumet Service Company versus the city of Chilton the Supreme Court has settled once for all the moot question as to whether the exclusive privilege conferred upon a utility by the indeterminate permit acts in a prohibitory way upon the municipality as well as upon others. It was held that the exclusive privilege enjoyed by a public utility as a result of an indeterminate permit received from the Railroad Commission excludes the municipality from going into the lighting business, even to the extent of doing its own lighting, except under the conditions and limitations of the public utility law; that is, either by taking over the existing plant by purchase or by demonstrating to the commission that public convenience and necessity require the establishment of a second utility.

MASSACHUSETTS COMMISSION.

The Gas and Electric Light Commission has dismissed the petition of the Fall River Gas Works Company for authority to issue 1150 shares of additional stock at the price of $225 per share, for the payment of obligations already incurred for construction and for future additions to plant. The decision is of particular interest on account of its treatment of the policy of declaring extra dividends. Section 20 of Chapter 109 of the Revised Laws provides that no gas or electric light company shall declare any stock or scrip dividend or divide the proceeds of the sale of stock or scrip among its stockholders. The board says: "There is every reason to believe that the company's income will afford ample provision, in addition to its regular dividends, for the plant additions proposed subsequent to 1911 and render a new issue of stock unnecessary for that purpose. Whenever, because of increased costs not now apparent or of future reductions in the price of gas, profits shall appear inadequate for the reasonably necessary purposes of the corporation the question of stock issue will be entitled to further consideration."

Current News and Notes

Tax on Incomes of New Hampshire Public Service Companies.—The New Hampshire State Constitutional Convention has adopted an amendment authorizing the Legislature to impose a direct tax on the incomes of public-service corporations.

* * *

Electric Service Publicity.—The Rochester (N. Y.) Railway & Light Company is publishing monthly for the information of its employees *Gas and Electric News*. It contains fifty-two pages of reading matter and illustrations particularly interesting to those associated directly or indirectly with the company. Mr. Joseph P. MacSweeney is managing editor and Mr. Victor T. Noonan is editor.

* * *

Welcome Home for Brooklyn N. E. L. A. Delegates.—Members of the sales department of the Edison Electric Illuminating Company of Brooklyn are to give a dinner on July 2 at Brighton Beach to the officers of the company returning from the Seattle convention. Mr. W. W. Freeman, the vice-president and general manager, and Mr. T. I. Jones, the sales agent of the company, will be the guests of honor.

* * *

The Gloriously Illuminated Sane Fourth.—Fifteen of the parks of New York City will be elaborately illuminated by means of incandescent electric lamps on the nights of July 3, 4 and 5. City Hall will be decorated with 6000 incandescent lamps, and use will be made of several search-lanterns. About 100,000 lamps are now being installed for the purpose by the New York Edison Company, which will furnish the entire service without cost to the city.

* * *

Wholesale Meter Swindling.—In arrests made last week of an ex-member of the New York police force and of a man employed at one time as a wireman by the New York Edison Company, Brooklyn detectives believe they have placed their hands on the men responsible for a wholesale tampering with electric meters, through which nearly $50,000 has been lost by the Edison Electric Illuminating Company of Brooklyn in the past nine months. Most of the thefts have been going on in amusement resorts in the Coney Island territory. Suspected premises have been kept under close observation by employees of the Brooklyn company and the latter now has a great accumulation of data with which it can check the energy registered by the meter with the actual amount used.

* * *

Rate Research Lamp Renewal Recommendation.—In our account of the report of the N. E. L. A. rate research committee, on page 1375 of our issue dated June 22, the following statement was made: "The committee stated that it is for the best interest of the public and the central stations that the rates should permit the free renewals of standard lamps and the offering of other lamps at such low prices as to prevent dealers from competing with inferior lamps." The secretary of the committee has requested us to add to the above statement the following, which concluded the sentence in the report from which the above statement was taken: "Or, if this policy is not adopted, the offering of lamps only at such prices as to encourage dealers to compete with a good quality of lamps."

* * *

Changes in New York City Wiring Rules.—On and after July 1, 1912, new code fixture wire will be required in New York City on all installations for which application for inspection is not on record prior to that date. On and after Oct. 1, 1912, new code rubber insulation will be required on all installations of flexible cord, armored flexible cord, reinforced flexible cord, canvasite and Crefield flexible cord, special stage cables, battery-charging cables, etc., for which applications for inspection are not on record prior to that date. On and after June 1, 1913, the introduction of wooden molding for electrical purposes in the city will be prohibited.

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SOCIETY MEETINGS.

Minneapolis Electric Club.—President Fred G. Dustin of the Minneapolis Electric Club announces that the annual outing of the organization will take place July 25, when a basket picnic will be held in a park near the city.

* * *

Chicago Mentioned as Next N. E. L. A. Convention City.—While no official action has been taken by the executive committee of the National Electric Light Association, it is reported on what seems very good authority that the 1913 convention will probably be held in Chicago.

* * *

Minnesota Electrical Contractors.—At the summer convention of the Minnesota Section of the National Electrical Contractors' Association, held at Duluth the second week in June, Mr. A. W. Lindgren, of the Northern Electrical Company, Duluth, was chosen president, Mr. G. M. Jones, Minneapolis, secretary, and Mr. W. Nimis, St. Paul, treasurer. The next meeting of the Minneapolis contractors will be held at St. Paul in January of next year.

* * *

Centralized Energy Production.—The commercial division and the contract department of the Commonwealth Edison Company Section of the National Electric Light Association held a joint meeting in Chicago on June 19 in the rooms of the Western Society of Engineers. Mr. John Burkhard, of the contracting department, read a paper on "Motor Installations," which discussed the desirability of centralizing generation and thereby reducing the cost of energy production to individual motors supplied with energy from isolated plants.

* * *

Los Angeles Section, A. I. E. E.—At a meeting of the Los Angeles Section of the American Institute of Electrical Engineers, June 11, Mr. F. Curt Miller presented a paper entitled "Purification of Sewage by Electrochemical Action." The system described was one assumed to be capable of purifying 1,200,000 gal. of sewage in twenty-four hours, with a current of from 15 amp to 20 amp at 3 volts. Samples of sewage thus treated were shown at the meeting and created considerable interest. The paper was discussed at length by Drs. Leon La Bonde, Julius Koebig and R. W. Sweet and Messrs. J. H. Leutzenheizer, R. W. Sorenson, W. T. Knowlton and Budd Frankenfield.

* * *

Electrical Contractors' Convention.—At the opening of the convention of the National Electric Contractors' Association to be held in Denver on July 17, 18 and 19 an address will be delivered by Governor John F. Shafroth on the resources of Colorado. An address will also be delivered by President M. B. Bisco, of the Denver Chapter of the American Institute of Architects, on the architect and the contractor, and one by Mr. A. F. Travers, superintendent of the Denver Gas & Electric Company, on the relation between the central station and the contractor. On the afternoon of the same day there will be a sight-seeing trip by automobile covering the entire city of Denver and some of the suburbs. In the evening at 8 o'clock there will be a reception and dance in the Convention Hall of the Albany Hotel. On July 18 will be served the annual dinner of the organization, followed by a vaudeville performance. On July 19 an all-day trip will be made over the Moffat road by special train. Business sessions for members only will be held on July 17 at 2 p.m., allowing ample time for the transaction of the work of the organization. The secretary of the association is Mr. W. H. Morton, 41 Martin Building, Utica, N. Y.

DEVELOPMENTS ON SPOKANE RIVER, WASH.—II.

Steam-Turbine Relay Station, Switching Stations and Substations of the Washington Water Power Company.

Interconnection of the Company's Various Stations and Method of Operating System, Which Possesses a High Load-Factor—Description of General Transmission System Embracing Circuits of Various Voltages.

DESCRIPTION of the newer developments of the Washington Water Power Company at Little Falls and at Long Lake was given in last week's article on the system. In the present article the steam-turbine station and the Post Street and Twenty-ninth Avenue substations will receive attention, as well as the general method of operating the system. As having a bearing on the steam-station design, it should be mentioned that slack coal at Spokane costs $4.23 a ton—a factor of considerable importance.

STEAM-TURBINE RELAY STATION.

When the flow of water in the Spokane River is unduly slack it has been found advisable under the present condition of development to operate a steam station as a relay to the hydroelectric properties. To help carry the load at such times or in emergencies there has been erected, at a place called Ross Park, within the city limits and on the Spokane River, a modern steam-turbine station capable of generating some 14,000 kw. The illustrations published herewith give a fair impression of the station design, its location and layout. It has not been used, however, to any extent since its erection, all told probably not more than six months; but it has amply proved its worth.

The building is of red brick resting upon a reinforced-concrete foundation. The walls of the turbine room rise 76 ft. 4 in. above the turbine-room floor, and the walls of the boiler room are 53 ft. 3 in. above the boiler-room floor. All trenches and well covers are made watertight so that exceptionally high water is not liable to flood the turbine room. Two large main doorways, one in the east end of the boiler room and the other in the northerly end of the turbine room, are provided for bringing in heavy material. An annex built on the western side of the turbine room contains the oil room, blower room, tool and supply room, workshop, etc. Located directly over the office is a storage-battery room, energy from which is used for operating the switchboard lamps and motor-driven switches. Abundant natural illumination is obtained throughout the entire structure.

The turbine room is equipped with a 40-ton Case traveling crane, having a span of 37.5 ft. The motors, of which there are four, the main hoist being rated at 40 hp and the auxiliary hoist at 25 hp, are of the direct-current, 110-volt series type, receiving energy from the exciter bus. Located in the northerly end of the turbine-room annex is the laboratory. There is provided the necessary apparatus for performing the simpler and common tests on oils, fuels and flue gases. The equipment comprises coal-sampling apparatus, flue-gas sampling apparatus, flue-gas analyzer, fire and flash test machines, reduction oven, Parr calorimeter, viscometer, chemical balance and weights.

The boiler-room equipment comprises twelve water-tube boilers of the Aultman & Taylor type, set in batteries of two and rated at 500 hp each. The boilers are suspended from steel supports and are equipped with superheaters and eight of them with stationary grates. The settings are built of common red brick, firebrick-lined, and are cement capped, the steam drums being covered with cement arches for heat insulation. The four last boilers to be installed differ somewhat in arrangement from the other eight in that they are equipped with rocking instead of stationary grates and the steam drums are covered by means of vitrobestos instead of cement. The settings are also 1 ft. higher. As will be noted from Fig. 2, the boilers are arranged on either side of the room with a firing aisle in the center.

Fig. 1—Main Substation and Spokane Hydroelectric Station of Washington Water Power Company at Lower Falls of Spokane River in the Heart of the City.

FEED-WATER SYSTEM.

The boiler feed-water system includes two Cochrane open feed-water heaters and three Epping-Carpenter feed-water pumps. The heaters receive their water supply directly from the hot-water tank into which the condensate and make-up water find their way. The heaters are inter-

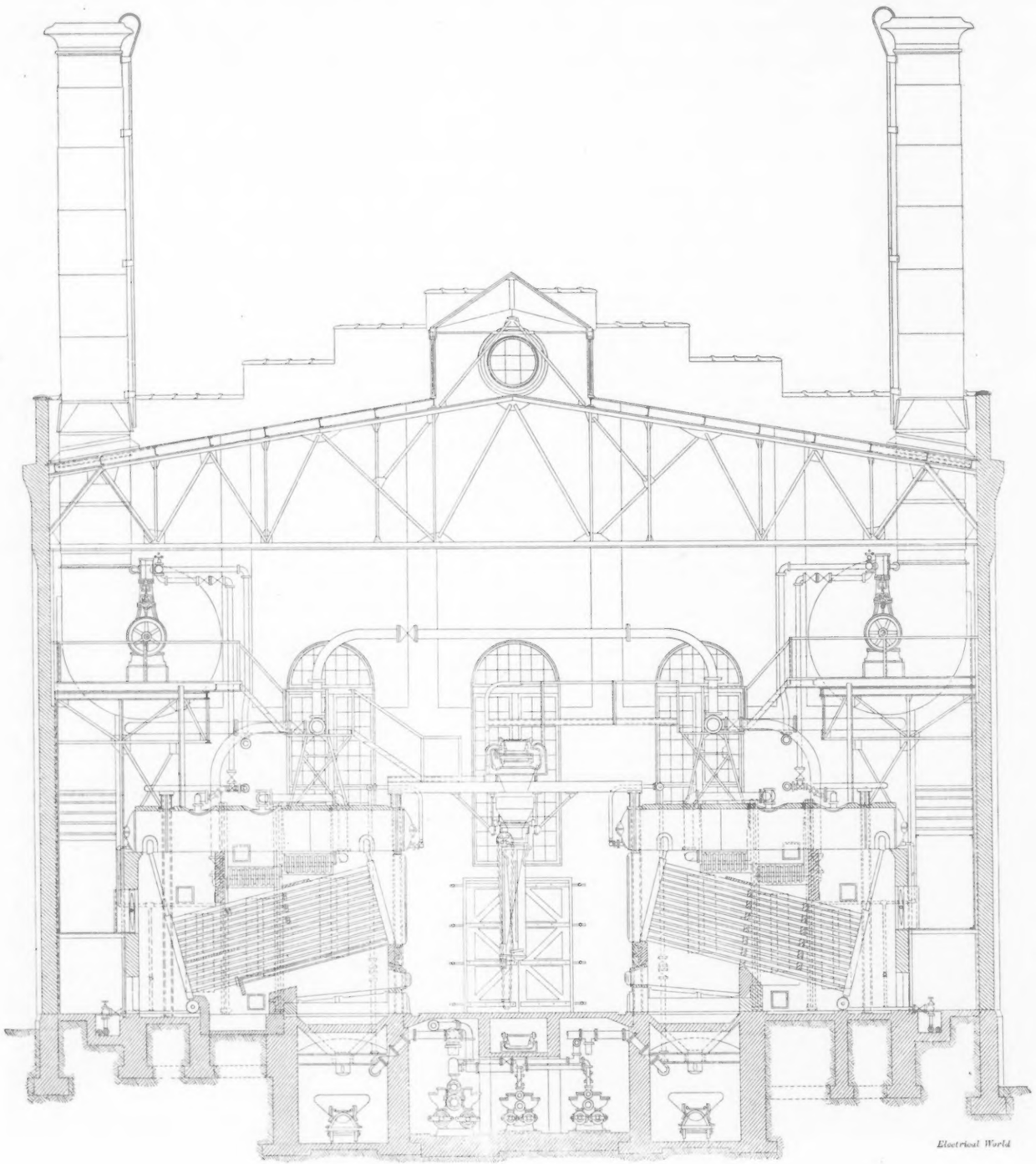


Fig. 2—Sectional Elevation of Boiler Room, Spokane Steam Station.

connected by a 4-in. equalizing pipe, and from the bottom of both there is an 8-in. water line which makes a circuit beneath the floor level and passes to the feed pump room located at the western end and beneath the boiler room. From this 8-in. line the three boiler-feed pumps take their supply. The three pumps feed a 6-in. cast-iron header built on the loop system from which 2.5-in. brass pipes branch vertically to the boiler room. The connections to the boilers are taken from these feed riser loops. Inserted in each of the connections is a combination stop and check valve which automatically closes in case there is a reversal of flow.

The arrangement of valves in the heater and feed-pump connections is such as to give the utmost flexibility and permit cleaning and repairs without disturbing the system. The feed-water heaters are rated at 3000 hp each.

COAL-HANDLING SYSTEM.

The coal-handling facilities at the station consist of a spur from the Great Northern Railroad which, crossing over scales at an elevation, branches, one branch descending and passing directly to the turbine room and the other

branch ascending to the coal embankment and trestle. The cars upon the trestle may be unloaded manually or by an unloader of special design similar to that employed in unloading grain cars. If the coal is unloaded in hopper cars, they simply dump their fuel into the yard beneath the trestle.

Coal is delivered to the boiler room by an Exeter Machine Company's bucket conveyor driven by a 30-hp induction motor through a triple gear reduction. The coal can be crushed if necessary by a coal cracker driven by a 30-hp induction motor. The buckets of the conveyor are loaded by a bucket loader so arranged on a track that the buckets may be filled from the coal cracker directly or from a storage hopper. Two movable bucket-tripping devices are located on the upper ingoing side of the bucket circuit, one for dumping the buckets into the storage hopper and the other for dumping the buckets into the weighing hopper. The latter is suspended from a movable truck and from it the fuel is dumped to the floor below.

Fig. 3—Turbine Room, Spokane Steam Station.

ASH-HANDLING EQUIPMENT.

For the disposal of ashes there are two tunnels almost the full length of the boiler room, whose axes are directly beneath the centers of the ash pits. The latter consist of concrete hoppers protruding into the tunnels and provided at their lower ends with double clamshell gates. Running transversely with the boiler room and extending outside of the building line is a third tunnel whose southerly end comes up to the street level and whose northerly end serves temporarily for housing the boiler from which the plant

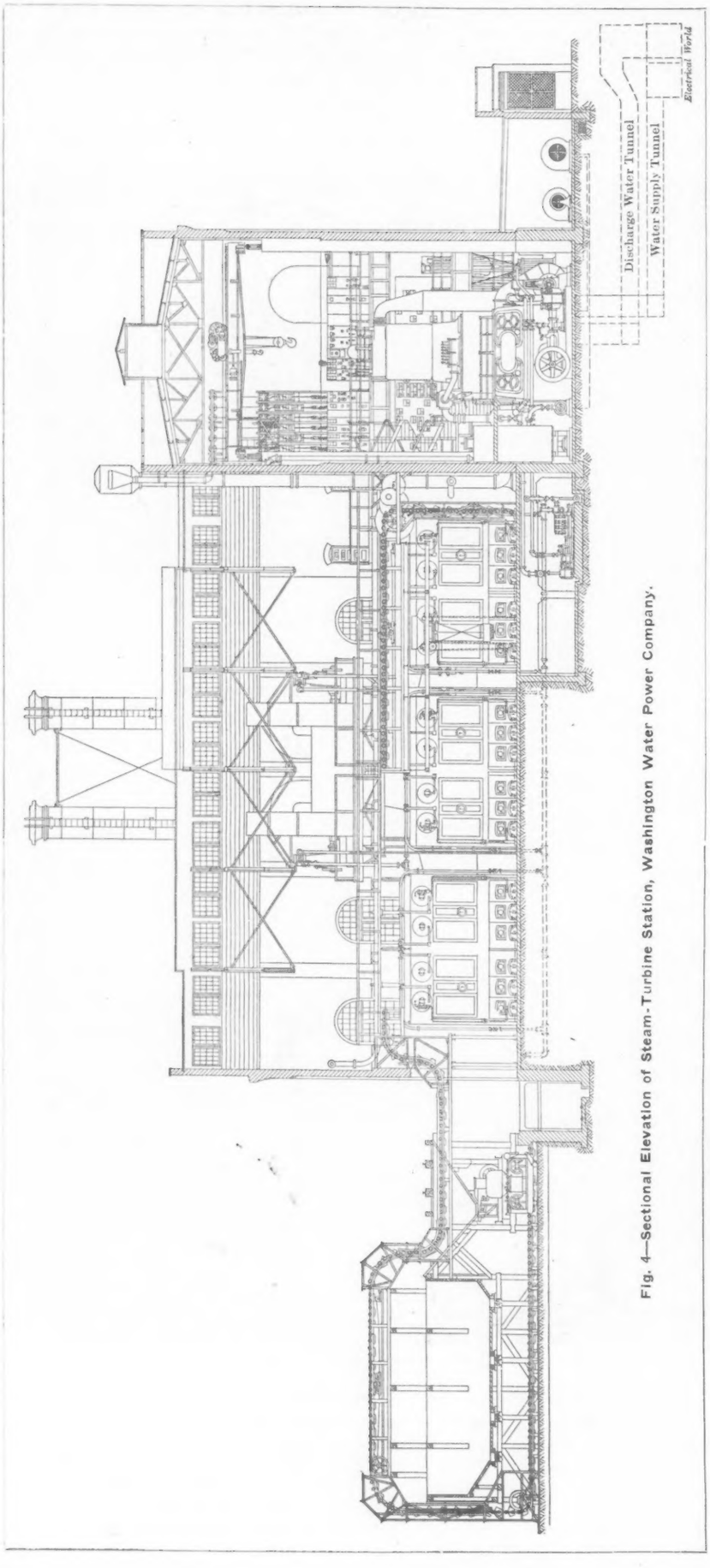


Fig. 4—Sectional Elevation of Steam-Turbine Station, Washington Water Power Company.

is heated during the winter months when the station is not in use. A 24-in. gage track embedded in the concrete floor of all three tunnels serves for the ash cars, and at the junctions of the lateral tunnels with the trunk tunnel are ball-bearing turntables. At the point to the south side at the center line of the building and coal conveyor is an elevator shaft.

The ashes are drawn out of the ash pits into cars which are dumped on the low land outside the station and adjacent to the river; or the ashes can be hoisted 60 ft. to a storage bin and dumped thence into standard cars. The operating mechanism for the elevator was made up of materials left from the construction plant and is driven by a worm shaft connected to a 5-hp induction motor.

STACKS, FLOORS AND BREECHINGS.

Running lengthwise of the boiler room are two steel breechings passing between the rear end of the settings and the outside walls, being connected with each setting by a steel thimble provided with a butterfly damper. At the central point of each breeching there is an uptake connecting it with the blower intake chamber. The blowers are of Buffalo Forge Company's build and are driven by simple piston-valve engines. The fans are of the overhung type.

Rising vertically from the wall sides of the blower casings are two steel stacks 5.5 ft. in diameter and extending 84 ft. 2 in. above the grates. Regulators are inserted in the supply line to each engine, which are in turn controlled by damper regulators in such manner that the speed of the blowers varies inversely with the variation in steam pressure. All of the surfaces of the blowers and breechings are lagged in order to keep down the temperature of the boiler room during warm weather.

HIGH-PRESSURE STEAM SYSTEM.

The high-pressure steam piping includes two systems complete with traps and trap lines, namely, a superheated steam system and a saturated steam system, each of which is independent of the other during normal operation but so built that they can be interconnected if necessary.

The two main generating units are supplied with steam from the superheater headers, while the auxiliaries receive their supply from the saturated steam lines. The pipe joints on the superheated lines are of the Van Stone & Crane lap type and all valves and fittings are of steel. Valves 8 in. and over are of the rising-stem type with nickel steel stems and trimmings, and valves 10 in. and 12 in. in size are provided with by-pass valves.

All valves 8 in. and above in the boiler connections and the main headers, except the stop and automatic check valves, may be closed from the boiler-room floor.

The main header is divided by valves into sections corresponding to each battery, the central section of each main header comprising an expansion loop made up of four 10-in. quarter bends. An 8-in. chain-operated gate valve is placed near each boiler superheater and an 8-in. stop and automatic check valve is placed in the boiler connection with the main header. An 8-in. quarter bend placed between these valves completes the boiler connection to the superheated steam header. There are two 4-in. saturated steam headers which combine into one 6-in. header in the turbine room for supplying the auxiliaries.

EXHAUST SYSTEM.

All of the various auxiliaries, including the blower engines and the feed-water pumps, exhaust into a common header leading to both heaters and also with the atmospheric exhaust from the turbines. The exhaust from one of the circulating pumps can be turned into the third stage of the turbine to which it is connected.

TURBO-GENERATORS.

The two main generating units are of the General Electric type, one being a four-stage, 5000-kw machine running at 720 r.p.m. and directly connected to a 10-pole, 60-cycle, three-phase, 13,200-volt generator by means of a one-piece shaft guided by an upper, middle and lower bearing, and with the entire weight of the unit carried on a step bearing. The turbine is provided with an overspeed tripping device which operates when the speed becomes excessive, in which case the generator will run as a synchronous motor until normal conditions can be re-established. The upper end of the generator is provided with a hood and connection to a forced system of ventilation.

The second unit is a five-stage, 9000-kw machine of the same general characteristics as the other machine, but connected to the generator by means of a flexible shaft. The latter is made in two pieces, the lower piece carrying the steam turbine and having at its top a flexible-disk diaphragm coupling which is keyed to the shaft. The field structure

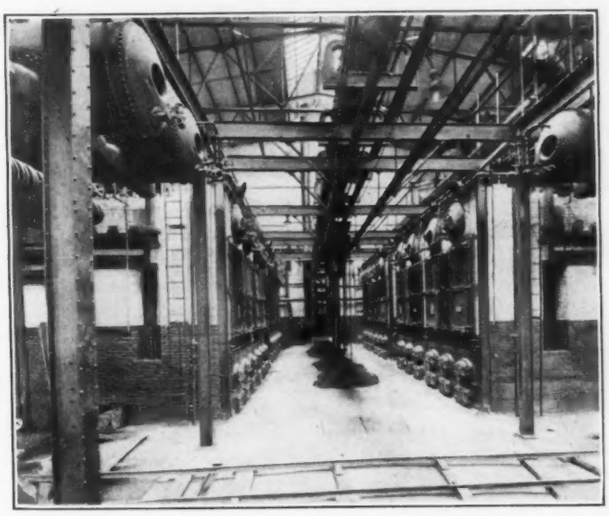


Fig. 5—Boiler Room, Steam-Turbine Station in Spokane.

of the generator is placed on the upper part of the shaft by means of a taper fit which will allow the field structure to slip a small amount in case of shocks produced by severe short-circuits.

To keep down the generator temperatures at heavy loads a system of ventilation has been provided and two motor-driven blowers, one rated at 30 hp and the other at 40 hp, installed. The blowers discharge into an underfloor air duct which rises up through the turbine-room floor near the intake wells. From the floor level for a distance of about 10 ft. is a rectangular sheet-iron duct provided with two connections extending to the ventilating hood of each main generator.

The energy for excitation is supplied from two exciter

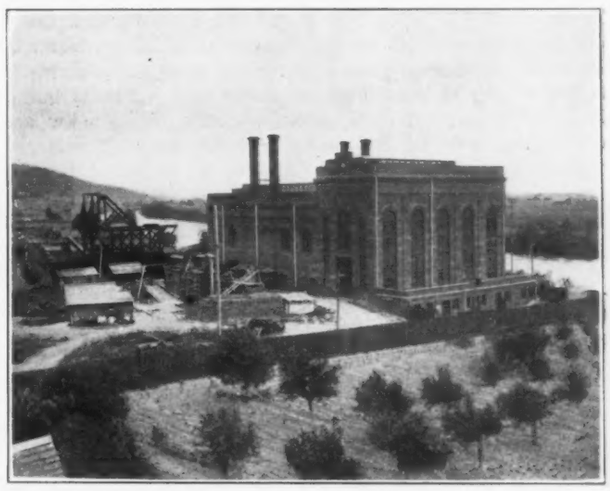


Fig. 6—Steam-Turbine Station, Washington Water Power Company, on Spokane River.

units, one an 85-kw motor-driven set and the other a 75-kw steam-turbine set. The latter is operated non-condensing and is equipped with a 125-volt interpole generator running at 2400 r.p.m.

CONDENSING SYSTEM.

The condensing system includes, besides the condensers for the turbo-generators, the necessary auxiliary apparatus. Both units are fitted with Worthington surface condensers. Circulating water is taken from the Spokane River by an engine-driven centrifugal pump, an intake tunnel leading from the river to a well beneath the pump. The rest of the equipment comprises a steam-driven vacuum pump and a duplex hot-well pump discharging into the feed-water heaters. In order to shorten the time for priming the circulating pump a weight-closed check valve is attached to the submerged end of the circulating discharge pipe, which valve closes automatically with the cessation or reversal of flow. A 4-in. flooding line from the house-service system enters the circulation head of the condenser and may be brought into service in emergencies. The hot-well pump of the larger condenser is driven by means of an induction motor.

LUBRICATING SYSTEM.

The step bearings of the two main units are floated and lubricated by means of a high-pressure oiling system, comprising three high-pressure, steam-driven pumps and two 50-gal. accumulators. The low-pressure, or guide-bearing, oil system is provided with lubricant taken from the oil filters and delivered at a pressure of 125 lb. by two steam-driven pumps. From this system the guide bearings and also both governors are supplied, the latter through equalizing tanks. The high-pressure and low-pressure pumps are equipped with relief valves so that the pressure cannot rise above the predetermined limit.

The majority of the ordinary bearings on the auxiliaries are lubricated by sight-drop gravity oil cups, but all steam cylinder lubrication is by means of sight-feed force pumps. All of the high-speed main bearings are equipped with a ring oiling system. Two 750-gal. tanks and one 500-gal. tank store the oil, which may be forced into the oil filters by air pressure.

OPERATING FORCE.

When the load assumes a constant daily value and the shifts are regular, the crew necessary for the operation of the station comprises one station foreman, one operator per shift, one engineer per shift, one conveyor engineer per shift, two oilers per shift, one fireman per boiler per shift, one extra fireman per shift, two laborers per shift, one mechanic's helper per shift, three water tenders, one mechanic and a janitor. Where the loads assume a fairly constant nature with intermittent peaks of short duration, steaming conditions give best results with one boiler per 1000 kw normal load, plus one boiler with a second boiler banked but not cut in. Loads in excess of 4000 kw are carried more easily and more economically on the larger unit, which also operates with less vibration and noise under full speed.

TELEPHONE AND ALARM-BELL SYSTEMS.

Telephone connections with the main office building of the company are had over a local connection to the company's local central and another over the transmission telephone line. Both sets of telephones are located in an insulated booth on the switchboard floor. The local telephone connection has a repeating coil inserted, so that the plant office telephone or the engineer's telephone located in the turbine gallery booth can be connected with the company's local central or the three plant telephones can be used locally without disturbing the rest of the system. The transmission telephone system is connected with the system operator's office and at the steam-plant end is provided with duplicate telephones and switch-over devices, together with alarm attachments and high-tension fuses. The ringing of either telephone operates a mercury-contact telephone drop which causes a bell to ring until the drop is restored. A watchman's time detector and fire-alarm system are also in use.

COMPRESSED-AIR SYSTEM.

A direct-current 5-hp, 110-volt series, motor-driven, duplex, single-acting, portable air compressor furnishes air at a pressure of 75 lb. for forcing oil from the storage tanks to the oil filters and for maintaining air in the guide bearing tanks. Compressed air is also used for cleaning

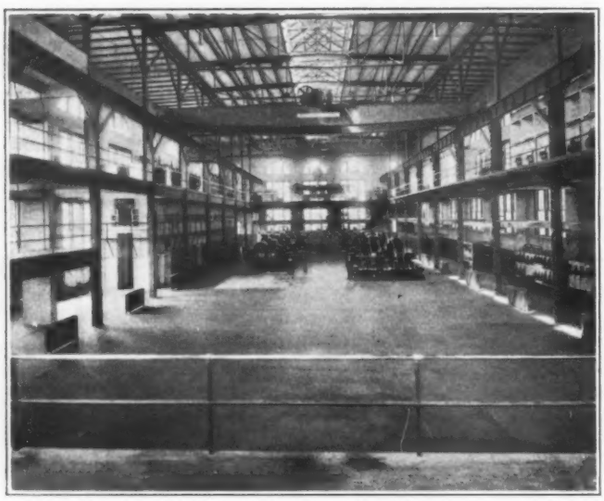


Fig. 7—Interior of Main Substation at Post Street, Spokane.

the electrical apparatus and after the spring high-water season for agitating and removing the deposit from the mouths of the intake and discharge tunnels.

SPOKANE HYDROELECTRIC STATION.

The Spokane hydroelectric station is located at Monroe Street and the river, where a head of 70 ft. is available on the lower falls. The output of the station is used chiefly in Spokane, and the station itself will eventually be displaced by a more modern plant on the upper falls, which will use the drop of both the upper and lower falls and employ probably a long tailrace tunnel after the fashion of the stations of the Niagara Falls Power Company and the Toronto Power Company at Niagara Falls. The

Fig. 8—Control Gallery at Post Substation.

present equipment of the station comprises 4500 kw in waterwheel-driven alternating-current apparatus, 1950 kw in 600-volt direct-current apparatus, and 2300 kw in 300-volt direct-current apparatus. In addition there are three convertible motor-generator sets aggregating in rating 2500 kw, which may be employed on either the 300-volt or the 600-volt systems.

POST STREET SUBSTATION.

The chief substation of the company is located on Post Street close to the business center of Spokane, one block from the general office building of the company and near the middle of the series of rapids which extend for half a mile along the Spokane River at that point. The Post Street substation was built as a low-tension distributing and converting station for the city service in Spokane. It is most liberally designed and will suffice for the demands of the system when the load has increased to several times its present value.

The first unit was placed in operation in October, 1909, and the sixth, or last, unit installed was placed in operation last March. Alternating-current energy enters at a tension of 13,200 volts over underground feeders from the Bishop's Court substation and from the hydroelectric station in Spokane just below the substation on Post Street. The energy is then transferred or converted into energy at the following voltages: Alternating current at 4000 volts for motor service, alternating current at 2300 volts for lighting service, direct current at 600 volts for railway service, and direct current at 250-125 volts for general industrial and lighting service in the heart of the city's business district. It should be mentioned that the Bishop's Court substation merely serves as a connecting link between the overhead 13,200-volt circuits and the underground 13,200-volt circuits running from Post Street to the Twenty-ninth Avenue switching station.

The present station equipment includes three 1500-kw and one 1000-kw motor-generator set for railway service, three 1500-kw motor-generator sets which deliver energy for the low-potential three-wire service, two exciter sets and a motor-generator booster set for charging the standby battery, two banks of single-phase and one three-phase transformer, the aggregate rating of which is 13,500 kva, for

reducing the potential of the incoming circuits to 4000 volts, four-wire, three-phase. The transformers are water-cooled and are equipped with low-water and thermostatic alarms. The water may be taken from the city water mains or by gravity from the river.

Four of the units mentioned above are driven by self-starting synchronous motors and the rest by induction

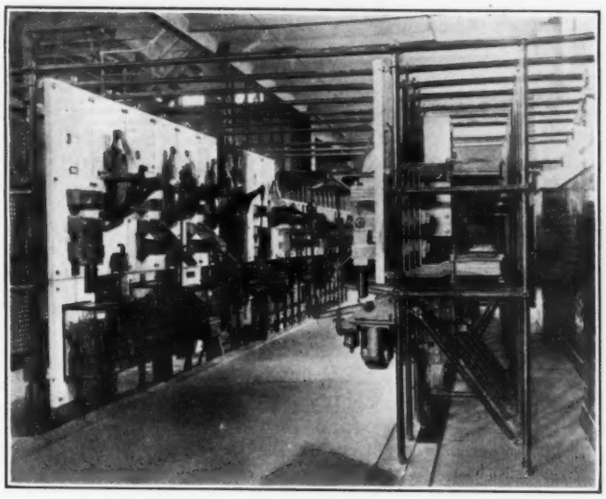


Fig. 9—Edison Disconnection Panel at Post Substation.

motors. Both the railway and the Edison generators are shunt-wound interpole machines. The former are operated in parallel with the railway machines in the hydroelectric station in Spokane, and regulation is mainly effected by the control of the latter. All incoming lines, circuits to and from the transformers, circuits to motors and all outgoing lines are controlled by remote-control, electrically operated oil switches. These are in the immediate control of the switchboard operator and meet every demand for simple and economical operation.

The bust structures are made up of brick walls supporting concrete slab floors. An electrically operated 35-ton crane with a span of 64 ft. travels the full length of the building. A standard-gage track connecting with the street-railway system enters the station at the end opposite from the benchboard. The dimensions of the main floor of this building are 200 ft. by 100 ft. The station is finished with a red tile floor and with green-glazed tile wainscot

Arranged around three sides of the building are the following switch structures: At the end under the benchboard gallery, a 13,200-volt oil-switch structure; on the left facing the room from the benchboard gallery, the railway, Edison and standby battery switchboards; at the right, the main 4000-volt switch structure and the current transformers with their panels for the arc-lighting system. On both sides of the building and on a level with the benchboard are the power and lighting switching structures. It should be pointed out that all of the lighting circuits and those intended for motor service are kept separated and independent throughout the entire system.

All control wiring is drawn in conduit and all conduit is exposed beneath the floor to facilitate change and removal. This feature is emphasized, as no station has yet been completed where demands have not been made for changes within a few years of the completion of the building. New inventions and changing operating conditions often play havoc with the original design. In the Post Street substation there is a minimum chance that any unforeseen change which has or may be made subsequent to the original design will disfigure the pleasing arrangement of the equipment.

All indicating meters are mounted either on the benchboard or on vertical panels at the back and to the right or left of the operator as he faces the benchboard. The circuits to and from the building pass through the downtown underground system, no aerial wires leaving the structure. The railway circuits are controlled by remote-control, electrically operated circuit-breakers and circuit-breaker type switches, the operating circuits being interlocked between the switch and breaker.

The standby battery consists of 150 cells of "Exide" battery, each cell containing seventy-seven plates. Sufficient end cells are provided to permit close regulation of the voltage, and these are controlled by four 14-point horizontal regulating switches. The rating of the battery for maximum emergency discharge is 19,000 amp for ten minutes. The one-hour amp capacity is 6346, the normal changing rate 990 amp, and the maximum charging rate 1318 amp.

The battery room is located in the basement of the building adjacent to the substation, and over it is a garage which stores the nine gasoline machines, five electric automobiles and five motor cycles of the company. Included in the electrics are one 2-ton, one 1-ton, one 1000-lb. and one 700-lb. truck. The first two are used by the line department and the other two by the meter department. They are giving satisfaction and are a feature in effecting considerable economy in the operating department.

The station is lighted by ten 6.6-amp, 100-hour inclosed flaming-arc lamps supported from the roof purlins. All apparatus is of General Electric manufacture except the battery, which was furnished by the Electric Storage Battery Company.

TWENTY-NINTH AVENUE SUBSTATION.

This substation, 2 miles from the center of the city, is primarily a high-tension distributing point. Into and from this station enter or leave the following 60,000-volt lines: Two circuits (on one steel tower) to Little Falls, 28.4 miles; two circuits (separate pole lines) to Post Falls, 28 miles; two circuits (separate pole lines) to Spokane power house, 2 miles.

To secure a degree of selection of circuits, the station is equipped with two 60,000-volt buses, to and from which energy may be fed through either of two disconnecting switches and an oil switch.

In addition to being a switching station, there are here installed five three-phase water-cooled transformers which

Fig. 10—Switching Station at Twenty-ninth Avenue, Spokane.

reduce the voltage from 60,000 to 13,200. These transformers have a capacity totalizing 13,200 kva. Power from these transformers is taken to Bishop's Court substation, located midway between Twenty-ninth Avenue substation and Post Street substation. From Bishop's Court the circuits are taken underground to Post Street substation. Each transformer may be connected to an individual

bus, and all these individual buses may be interconnected, or all transformers may be connected to a common bus. The three 13,200-volt feeders are subject to a like selective arrangement. All 60,000-volt and 13,200-volt circuits are protected by aluminum-cell-type lightning arresters. A vertical instrument board provides for reading the voltage and current on all lines and for pull switches for controlling

Fig. 11—Exterior of Post Street Substation.

the circuits to the electrically operated, remote-control oil switches. These control circuits receive energy from a storage battery which is charged by a mercury-arc rectifier. The transformers are equipped with low-water and thermostat alarms. After leaving the transformers the cooling water is sprinkled into a cooling pond from which it is pumped to a water tower. The original water supply is obtained from a well.

The wires of all circuits in the power houses and substations are phased out and painted significant colors. This applies to control circuits as well as to power circuits.

TRANSMISSION LINES.

The Post Falls station is connected to the Spokane plants by two entirely separate 60,000-volt transmission circuits, one a direct tie line and the other having branches, one to the Cœur d'Alene mining district in Idaho and the other to the Palouse Country in southeastern Washington. The Little Falls station feeds energy into Spokane over a duplicate steel tower line, a single circuit being arranged on either side of the tower.

The early lines of the company were strung on wooden poles, spaced 125 ft. apart and fitted with pin insulators. The wires are spaced on a 42-in. triangle. The Cœur d'Alene line No. 1, the Post Falls tie line and Medical Lake line are thus constructed. The second line to Cœur d'Alene is composed of aluminum, spaced on an 84-in. triangle with poles 200 ft. apart. What is known as the Big Bend line, 86 miles long, is composed of aluminum strung on poles spaced 300 ft. apart and arranged on an 84-in. triangle. A spur branch to Odessa, 20 miles long, is made up of No. 7 copper-clad wire strung on wooden poles spaced 350 ft. apart and arranged on an 84-in. triangle. The load on this copper-clad circuit is not heavy, but strength was required. The Palouse line, 63 miles long, is of aluminum arranged on an 84-in. triangle on poles spaced 200 ft.

The latest line other than the steel-tower line from Little Falls which is equipped with suspension insulators is the Pend Oreille line. This is erected on 50-ft. poles spaced 250 ft. apart, and the circuit is of No. 4 copper. The spacing of the wires is on a 7-ft. triangle, the top pin not being placed on the top of the pole, but on a small arm near the top. Along the top of the pole is a 3/8-in. steel ground wire. On all of the lines except that already noted standard porcelain pin insulators are used. The height of the poles varies according to the spans from 35 ft. for the shortest span to 50 ft. for the longest spans. The 13,200-volt lines are spaced in a 26-in. triangle on poles fitted with 9-ft. cross-arms.

SYSTEM OPERATION.

The system operator's office is located in the main office building of the company in a room adjacent to the superintendent's and assistant superintendent's offices. This location was selected so that in case of trouble the system operator might easily obtain instructions from his superior officers and thus centralize the seat of authority for the system.

The office is handled by four men, three regular operators and one relief man, who also, as part of his duties during the days he is not on relief shift, maintains the maps and records up to date. Each man is on duty nine consecutive hours per days, the morning operator's shift overlapping the afternoon shift by three hours. Located in the same room at a desk separate from the system operator's is a telephone attendant, who receives the periodical calls, regular reports and daily routine business done with the patrolmen and substation men along the high-tension transmission lines.

From this room direct communication can be had with all stations and substations by private telephone lines owned and operated by the company. Connections can also be made between the company's lines and the Bell Telephone Company's system, which is quite often used in cases of emergency. One interesting feature is the telegraph service to Little Falls power station over the telephone line, the one line being used simultaneously for telegraphing and telephoning.

Directly in front of the system operator's desk are six

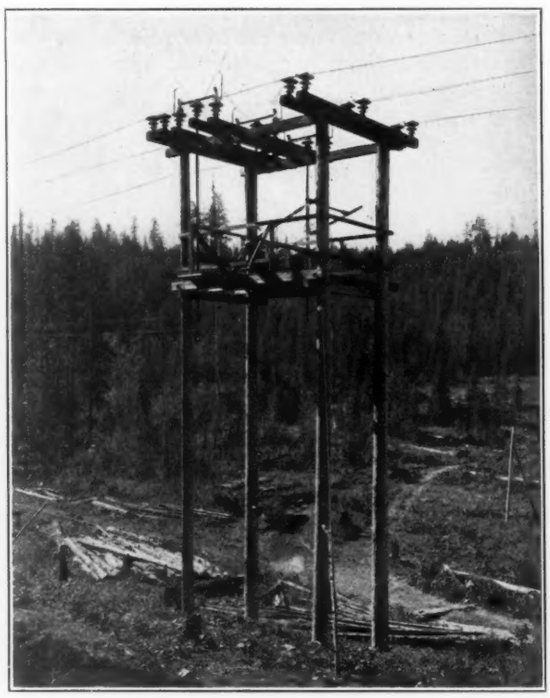


Fig. 12—Wooden Switching Tower on Cœur d'Alene 60,000-Volt Transmission Line.

Bristol recording voltmeters, which give the alternating-current voltage of the power delivered by each generating station, the voltage of the street-railway busbars at the power house and the pressure of the three-wire Edison system at the center of distribution. These meters give a continuous record of the voltage maintained on all the separate systems and give an instant notification to the

operator on shift when trouble occurs to destroy the constant potential.

Occupying the wall in front of the system operator is a large operating diagram showing all the high-tension transmission lines, tie lines, station busbars, substations and switching stations, placed there for the use of the operator in keeping record of switching conditions and operations. On this diagram the voltage of each system is represented by a certain color, as, for instance, 60,000-volt lines by green, 13,200-volt lines by red, 2300-volt lines by black, etc. Oil switches are indicated by holes in the board for push-pin tacks. When a switch is closed a pin is inserted in the hole. Oil switches are distinguished from the disconnecting and selector switches by different colored pins. The absence of a pin indicates that the switch is open, but in instances where men are to work on the line or piece of apparatus shorts and grounds are put on, and it is then represented on the diagram by red tags held to the line or apparatus by a push pin. If the line is only out of service for testing, then a green tag is substituted for the red. To protect men working on lines and apparatus further, the foreman in charge of the work to be done is required to have his name posted upon a blackboard in the system operator's office and each power station to which that line or apparatus may be connected, and under no circumstances would such a line or piece of apparatus be made alive again until cleared by the man whose name appears on the board against that line.

To the rear of the system operator is a complete set of maps of the various feeders and circuits, as, for instance, power feeders, light feeders, railway feeders, Edison underground feeders, arc circuits, etc., all kept in a convenient roller cabinet hung on the wall for ready reference. In addition to this an elaborate file of blueprints is kept at hand, giving all the detailed wiring diagrams of the sta-

Fig. 13—Transmission Line No. 1 to Cœur d'Alene Mines, Crossing St. Joe River, Near Chatcolet, Idaho.

tions, substations and switching stations and maps of the transmission lines. A fire-alarm recorder connected to the city's fire-alarm system gives the location of all fires in the city at first hand to the system operator.

In general, the system operator forms the head of the operating force and gives orders for the opening and closing of all switches, shifts the load according to the requirements and capacity at the various stations, controls the cutting in or out of all apparatus connected to the system, manipulates the Tainter gates, varying water levels —in fact, all work with any connection whatsoever with the operation of the system is carried on through the instructions of the system operator.

Under normal operating conditions the network of cir-

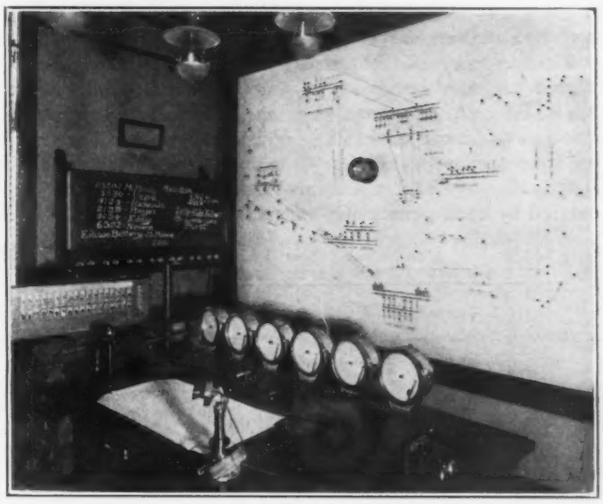


Fig. 14—System Operator's Room in Head Office.

cuits is divided into three separate electrical systems as follows: The Edison three-wire system, in order to be free from transmission line trouble, is carried by power generated at the Spokane power station either directly by direct-current waterwheel generators or through alternating-current generation and motor-generator transformation to direct current.

The second system is composed for the most part of transmission load—the Cœur d'Alene mining district, Pend Oreille, Palouse, Big Bend and Long Lake transmission lines, two-thirds of the city alternating-current lighting and motor-generator loads—all of which is supplied by Post Falls station and two units of the Little Falls power station connected together by a 60,000-volt tie line.

The third system consists of the remaining load in Spokane, one-third of the city alternating-current lighting and one-half of the city railway motor-generator load.

The two latter systems occupy practically duplicate transmission lines and station buses. Each system may be tied into the other or all three together as the case may require.

The operator receives from each station one-half hourly readings of the loads and water conditions, which he posts upon the system load sheet before him. From these records and the Bristol meters on his desk, he is able to keep close watch of conditions and make changes in load generation, voltage, frequency, gate openings, etc., in order to obtain the most satisfactory and efficient operation.

The real value of a system operator looms up under abnormal or trouble conditions. When trouble affects the system it is instantly apparent on the Bristol voltmeters, and if on the high-tension lines the telephone bells sound the alarm. The system operator immediately gets into communication with the station affected and in case of transmission line trouble learns what switches have opened and then if possible gives orders to cut over to duplicate lines. The faulty line receives one or two trials, either at full voltage or by bringing the voltage up slowly on separate generators. If the short or trouble still shows up on the line ammeters, the line is cut up into sections, according to the judgment of the system operator, and tried until the faulty section is located. Patrolmen and repair men, who are on constant call, then receive directions for making the repairs. In the case of trouble on the city dis-

tribution system, as, for instance, where a feeder will not stay in owing to a short on the line, it is immediately reported and turned over to the line department, which looks after the repairing of the line. In case of trouble with the underground system, the system operator supervises the locating and disconnecting of the faulty feeder and then notifies the underground department, whose business it is to repair the trouble. In case of trouble of a serious nature, the heads of the departments affected are notified and take active charge of the situation.

The reverse side of the system load sheet is used to record all note of trouble, switching or anything which has to do with the operation of the different lines or plants. Each day a curve called the "system curve sheet" is drawn up from the one-half hourly readings taken from the "system load sheet." On the curve sheet is shown the load carried by each generating station, the Edison system load,

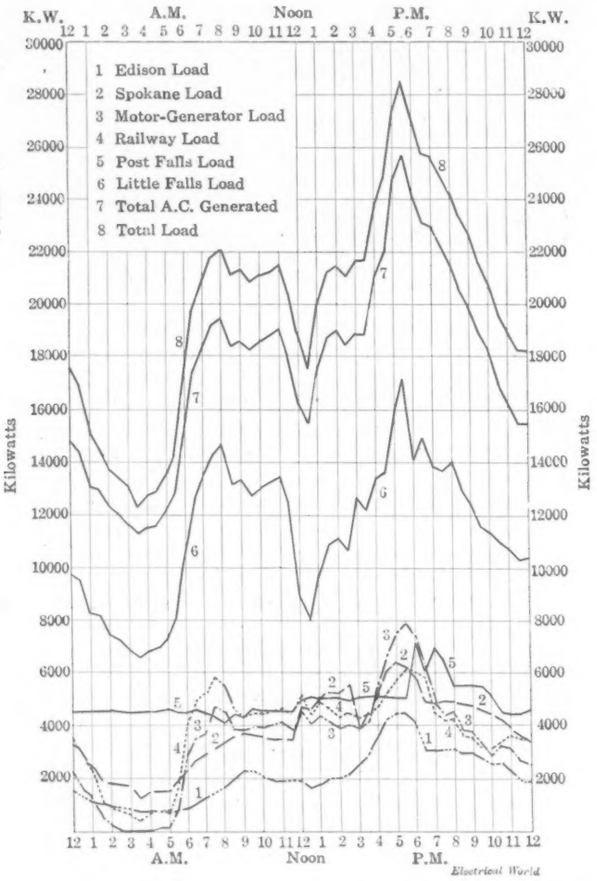


Fig. 15—Load Curves of the Washington Water Power Company.

the railway load, the motor-generator load, the total alternating-current generated and the total load, drawn in different colored inks, in order to differentiate the curves. At the top of the sheet a rubber-stamped form is filled out giving the kilowatt-hours, the maximum kw, the average kw and the load-factor for each plant and for the total load. Immediately below this form information regarding previous peaks is given, for instance on the total load, on the Edison system, on the railway system, etc.

Elsewhere in the system operator's office are kept records of Cœur d'Alene Lake elevations, flow of the river in second-feet, kilowatt-hours and maximums on the Edison system, kilowatt-hours and maximums on the railway system, kilowatt-hours and maximums on the arc system, kilowatt-hours and maximums on the total system, and various other records pertaining to the system operator's office.

A card index is kept of all cases of trouble, dates of new installations of apparatus, changes made, relay settings and all vital points of information, which by this means may be rapidly located.

Since the installation of the system operator's office in 1908, alterations and changes have been made as the exigencies demanded, until at the present time the office has become very well organized and the men well trained, which fact has accounted to a large extent for the quickness with which service is re-established after an interruption and for the uniformly good service rendered by the company.

GENERAL INFORMATION ON SYSTEM.

As a matter of general interest the curves showing the various loads on a single day and mentioned under "system operation" are reproduced. The daily load-factor of the system averages 75 per cent and has gone as high as 80 per cent. The annual load-factor for the year ended Dec. 31, 1911, was 53.7 per cent. Of special interest is the kilowatt hour output for the year ended March 31, 1912, showing for the system 139,075,021 kw-hr.

The stations of the company are operated very economically as regards labor and attendance. The Post Falls station is operated by eight men, including the foreman; the Little Falls station is also operated by eight men, and the staff at Long Lake will not be any larger. This does not mean eight men on a shift, but eight men for the entire twenty-four hours' operation.

The Washington Water Power Company's staff is as follows: President, Mr. D. L. Huntington; first vice-president, Mr. Henry M. Richards; second vice-president, Mr. H. L. Bleecker; general manager, Mr. C. S. MacCalla; superintendent of light and power, Mr. J. B. Fisken; superintendent of railways, Mr. R. A. Willson; chief draftsman, Mr. C. F. Uhden; electrical engineer, Mr. V. H. Greisser; mechanical engineer, Mr. W. H. Fawcett; superintendents of construction, Messrs. A. J. Turner and F. F. Griffin, and commercial agent, Mr. M. C. Osborn.

REPAIRING 25,000-VOLT TRANSMISSION LINES IN SERVICE.

All repairs on the 25,000-volt, 30-cycle, three-phase transmission line connecting the Cripple Creek gold-mining district with Canon City, Col., where the Arkansas Valley public-service company's turbine plant is located, are handled and completed with perfect impunity while the line is in service. Owing to Colorado's very dry atmosphere and high altitude, a lineman standing on one of the wooden line poles can touch and hold the charged conductors without danger and with practically no sensation. Such work is attempted, of course, only when the poles themselves are thoroughly dry. Even a few minutes' drizzle of rain will render the wood sufficiently conducting to give a man a bad shock, but most of the time in the Canon City country the poles can be relied upon for effective insulation for doing this work.

No gloves or insulated-handle pliers are permitted to be used when repairing this 25,000-volt line. Standing with his climbers on the pole, the lineman, after first assuring himself that his own body is clear of grounds, makes the initial contact with the wire through his bare pliers, receiving the spark and charging current on the metal. The other hand is next laid on the wire and held there during all the work, thus keeping the body charged to line voltage. When the job is finished contact is again made with the pliers, the free hand is removed, and lastly the pliers are taken off, drawing the spark on metal as before. Of course a tie wire or any metallic object can be used quite as well as the pliers, the purpose of the metal being simply to avoid sparks entering the flesh and causing burns or blisters.

COMMUTATION.

A Discussion of Various Theories Relating to Commutation and Their Practical Application.

BY F. W. CARTER.

IN a former article[1] the author discussed the question of commutation with particular reference to the phenomena occurring near the end of the commutation period and to the form of commutating field required to reverse the current with uniform density over the contact surface of the brush, deducing in general form the inequality whose satisfaction indicates finite current density throughout and proving the effective value of the inductance to be the ratio of a certain determinant to its chief minor.[2] In the present article he purposes to discuss the matter more from a physical standpoint—to interpret experience in commutation by the light of the results obtained, with a particular view of showing their relation to the observed phenomena.

It is perhaps advisable to remark at the outset that such mathematical language as was freely used in the former article often requires to be mentally interpreted, as expressing in strictness more than is physically possible or actually intended. When it is stated, for instance, that the current density under certain conditions tends to become infinite no more is implied than that as the final state is approached the current density continually increases, and at an increasing rate. It will invariably be found, however, that before the final state is reached the underlying assumptions cease to apply, and the current density may actually be everywhere quite moderate, although increasing as indicated by theory, so long as the primary assumptions remain substantially true. Thus, taking Fig. 1 as representing on a large scale a portion of a brush and commutator near the end of the commutation period, the resistance of contact on the toe segment may reasonably be taken as varying as x—the amount by which the toe overlaps the segment. At a little later time, however, when the commutator has reached the position shown in Fig. 2, the contact resistance cannot be assumed to vary in this manner, and equations that are sensibly correct under the conditions of Fig. 1 no longer apply. Some such development should be looked for whenever mathematics indicates a physically impossible result.

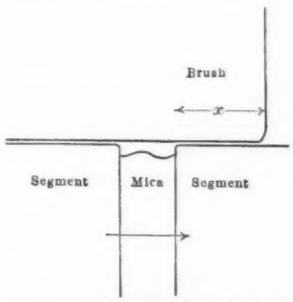


Fig. 1—Approaching End of Commutation.

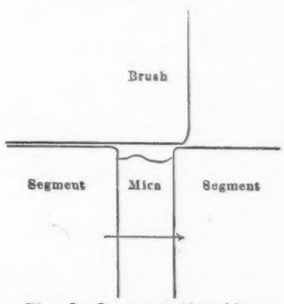


Fig. 2—Commutation Very Nearly Complete.

The inequality,

$$\frac{RT}{L} > 1 \qquad (1)$$

the correct calculation of which was discussed in the former article, is here presented in its usual form,[3] which form, however, is not really suitable for showing the nature of the elements on which it depends. The formula is deduced from conditions obtaining just at the end of the commutation period and should not therefore contain factors, such as the total contact resistance and the total time of commutation, which pertain to the whole reversal.

However, it is easy to express the inequality in terms of more appropriate elements. Taking R_o as the contact resistance per unit area, v as the peripheral velocity of the commutator, l as the axial length of the contact area of a row of brushes, then, since vT is the breadth of a brush, $RT = R_o \div vl$, and the inequality can be written:

$$vlL < R_o \qquad (2)$$

The condition of natural commutation is here expressed in terms of its true elements and is shown to depend on the velocity of the commutator, the final axial length of the contact area, the effective inductance of the armature coil and the specific contact resistance of the brush.

There is still another form in which the condition can be written, a form which elucidates the rule employed largely by designers of commutating machinery. If, as is customary, $1 \div 2T$ be called the frequency of commutation and $2\pi LI \div 2T$ the reactance voltage—I being a half of the current collected—the inequality (1) reduces to:

$$\text{reactance voltage} < \pi RI$$

$$< \frac{\pi}{2} \times \text{contact drop of potential} \qquad (3)$$

The reactance voltage is frequently calculated in more or less arbitrary units, for comparative purposes; the above inequality will, however, still hold good if an appropriate constant be substituted for $\pi \div 2$. The rule that for good commutation the reactance voltage should not exceed a certain amount determined by experience is, therefore, merely a form of what the author describes as the condition of natural commutation.

It should be noted that the contact resistance arising in this connection is not the resistance as usually measured. The voltage drop between brush and commutator at practicable current densities may be conceived as made up of a more or less constant ionization voltage and a true resistance voltage. Only the latter is effective in this connection. At very great current density, assuming no new effect to come in, this element predominates, so that the resistance in question may, as in the former article, be called that at very great current density. It is, however, better described in mathematical language as the increment of contact voltage per unit increment of contact current density, or as the slope of the current-voltage curve for the contact surface. Its value for well-bedded carbon brushes seems to be from 0.005 ohm to 0.015 ohm per square inch for either the positive or the negative brush, depending largely on the specific resistance of the material and the peripheral speed of the commutator.

The inequality which expresses the condition of natural commutation merits further discussion, for, although by itself it is far from furnishing a decisive test of satisfactory operation, it serves well as a starting point for more conclusive reasoning.

Writing

$$\frac{RT}{L} = \alpha$$

so long as α is greater than unity the current between the toe segment and the brush, near the end of commutation, approaches the form $c = Ax$ where A is a constant and x the fraction of the brush width (vT) covered by the toe segment. The current density tends toward the limit $Ax \div lvTx$ or $A \div lvT$, a constant. Here A varies inversely as $\alpha - 1$ and thus tends to become large as α approaches unity. The principal term in its numerator is proportional to the resultant field in which reversal takes place, and thus A can be made anything if the appropriate commutating field be provided. The power dissipated between toe segment and brush tends toward $R_o A^2 x \div vT$, which is ultimately evanescent.

[1] *Electrical World*, March 31, 1910.

[2] This result was obtained independently by M. Latour and published a few days after the author's article appeared. See *Bulletin* de la Société Internationale des Electriciens, April, 1910, page 265.

[3] Note that L is here used for the effective inductance of the coil about to finish commutation, the quantity designated by Λ in the former article, whose value was found as the ratio of two determinants.

When, however, α is less than unity, the current between the toe segment and the brush approaches a limit of the form $c = Ax^{\alpha}$ as x diminishes. The current density then varies as $x^{\alpha-1}$, which increases indefinitely as x decreases. The power dissipated between the toe segment and the brush now tends toward $R_0A^2x^{2\alpha} \div lvTx$; that is to say, it varies as $x^{2\alpha-1}$. If, therefore, 2α is greater than unity the rate at which energy is dissipated under the toe still tends toward zero at the end of commutation. There appears, then, no reason for necessarily expecting trouble from sparking so long as 2α is greater than unity, as sparking is certainly impossible without expenditure of power. Unless a suitable commutating field be provided, however, some glowing may be anticipated at the toe of the brush, due to high current density in this region.

It would seem, then, that the inequality which divides the region of limited current density from that of indefinitely increasing current density does not necessarily divide the regions of good and poor commutation. A better limiting criterion is suggested by the above reasoning, which makes the inequality—expressed in the forms corresponding to expressions (1), (2) and (3) respectively—

$$\frac{RT}{L} > \frac{1}{2} \tag{4}$$

$$vlL < 2R_0 \tag{5}$$

$$\text{reactance voltage} < \pi \times \text{contact drop of potential} \tag{6}$$

For these days of exact commutating fields the above criterion may be considered on the conservative side, for, irrespective of the fact that the ordinary calculation of L gives a result somewhat greater than its true value, the axial length of final contact in (5) is certainly not greater and may be less than the axial length of brush surface, while rounding of the edge of the brush or commutator segment (see Fig. 2) tends to increase R_0 at the end of the commutation period.

However, to return to the above chain of reasoning, if 2α is less than unity the rate of discharge of energy continually increases as the end of the commutation period approaches, and the criterion of sparklessness must now be sought in the total amount of energy remaining to be discharged when the assumptions underlying the reasoning no longer hold. If c is the current between toe segment and brush when the circuit is broken, the energy in the resulting spark is[4] $\frac{1}{2}Lc^2$, where L has the same value as before. For satisfactory commutation this should be for every reversal less than some quantity marking the limit of admissible sparking.

Where every coil is similarly situated on the armature and similarly treated by the field—as in a continuous-current machine having one coil per slot—it is practicable, while the commutator is smooth and true, to secure sparkless commutation by close adjustment of commutating field, even when the condition represented in expressions (4), (5) and (6) is not satisfied. Whether it is practicable to insure similar wear on all commutator segments, to maintain constant trueness of commutator and uniform condition of brush and commutator surface, and to keep the correct commutating field at all times and at all loads, the author is not prepared to say, but inclines to the opinion that it is advisable, even at considerable sacrifice, to satisfy the above condition of sparklessness.

Where the commutator runs at high peripheral speed a very small defect suffices to produce dissimilarity in the reversals. Consider, for instance, a commutator 10 in. in diameter and running at a speed of 3000 r.p.m., on the surface of which a soft bar or other cause has resulted in a slight flat. Let the maximum deviation from the true circle be 0.002 in. and assume this maximum to be approached and left in a smooth and gradual manner so that at ordinary speeds its existence would hardly be noticed. Let the whole area affected extend for 15 deg. on each side of the maximum and the radius of the commutator between -15 deg and $+15$ deg. be represented, in inches, by

$$r = 5 - 0.001\,(1 + \cos 12\,\theta) \tag{7}$$

Fig. 3 represents a portion of the commutator with the flat magnified about 2500 per cent.[5] Let the brush be capable of radial movement only and assume it to be pressed toward the commutator with a resultant force of 1 lb. for every ounce of brush weight, so that its radial acceleration when free is sixteen times that of gravity, or, measured outward:

$$f = -16 \times 12\,g = -6170 \text{ in. per second per second} \tag{8}$$

The angular velocity of the commutator is

$$\frac{d\theta}{dt} = 100\,\pi = 314 \tag{9}$$

The radial velocity of a point kept in contact with the commutator over the flat would be

$$\frac{dr}{dt} = 0.001 \times 12 \sin 12\,\theta\,\frac{d\theta}{dt}$$

$$= 3.77 \sin 12\,\theta \text{ inches per-second} \tag{10}$$

The radial acceleration of such a point would be

$$\frac{d^2r}{dt^2} = 3.77 \times 12 \cos 12\,\theta\,\frac{d\theta}{dt}$$

$$= 14{,}200 \cos 12\,\theta \text{ in. per second per second} \tag{11}$$

When the point P (Figs. 3 and 4) reaches the brush, the latter leaves the commutator, as its acceleration is only

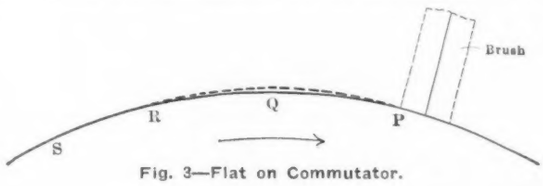


Fig. 3—Flat on Commutator.

6170 in. per second per second inward, instead of 14,200 in. per second per second, as would be required to keep it in contact. The brush returns to the commutator at Q, after an interval of time t given by the expression

$$\tfrac{1}{2}ft^2 = r - 5 = -0.001\,(1 + \cos 12\,\theta)$$

or

$$3085\,t^2 = 0.001\,(1 - \cos 3770\,t) \tag{12}$$

giving

$$t = 8 \times 10^{-4} \text{ seconds} \tag{13}$$

The brush, therefore, loses contact with the commutator for an angular space of 14½ deg., or a peripheral space of 1¼ in. on the commutator surface. Its radial acceleration then takes the value determined by contact with the commutator surface and remains at this as far as the point R, where this acceleration is equal to f. This point, at which the brush again leaves the commutator, is determined by the expressions

$$14{,}200 \cos 12\,\theta = -6170$$

or

$$\cos 12\,\theta = -0.434$$

or

$$\theta = 9.65 \text{ deg.} \tag{14}$$

At R the radius is $r = 5 - 0.001(1 - 0.434) = 5 - 0.000566$, and the radial velocity of the brush is $3.77 \sin 12\,\theta = 3.4$ in. per second. The brush, having lost contact at R, returns to the commutator at S, after an interval of time given by:

$$5 - r = 3.4\,t + \tfrac{1}{2}ft^2$$

or

$$3085\,t^2 - 3.4\,t + 0.000566 = 0 \tag{15}$$

giving

$$t = 9 \times 10^{-4} \text{ seconds} \tag{16}$$

The brush, therefore, loses contact on this occasion for an

[4] If $c = Ax^{\alpha}$, where $\alpha = \frac{RT}{L}$, the total energy remaining to be discharged is

$$w = \int_0^x R_0\,\frac{A^2x^{2\alpha}T}{lvTx}\,dx = RTA^2\int_0^x x^{2\alpha-1}\,dx = \frac{RT}{2\alpha}A^2x^{2\alpha} = \frac{1}{2}Lc^2$$

though, of course, the result is much more general than this reasoning.

[5] In Fig. 3, $r = 5 - 0.025\,(1 + \cos 12\,\theta)$ approximately.

angular space of 16.2 deg. or a peripheral space of 1.4 in. on the commutator surface. The path described by the end of the brush with reference to the commutator is shown, with the flat very much exaggerated, in Fig. 4. An actual brush is, of course, capable of small motions other than in a radial direction, while its contact with the commutator is not properly represented by a fixed point on the contact surface. These considerations, however, do not affect the general conclusion that a commutating field adjusted to suit a normal reversal is not likely to suit reversals about a flat on a commutator. It seems injudicious then to rely entirely on an exactly adjusted field for good commutation, and machines designed in accordance with this principle, although operating well in the shops, may be found to develop commutating troubles at a cumulative rate after a period of service.

If a machine in which the condition of sparklessness is not satisfied be loaded at various speeds, it will be found that below a certain speed some latitude is permissible in the commutating field, while above this speed close adjustment is necessary for sparkless operation. The speed at which an exactly adjusted commutating field becomes necessary doubtless corresponds with the limit indicated by expression (5). Below this speed the brushes themselves tend to finish the reversal sparklessly, while above it the reversal is controlled by the field.

The advent of the commutating pole has so greatly reduced the difficulties of commutation that the minute discussion of the action of the brush would seem to be regarded by some as a rather useless refinement. However, those who have to deal with machines in which high reactance voltage is unavoidable will realize the importance of the matter to the attainment of permanent satisfaction.

In large direct-current turbo-generators smooth-core armatures are still very largely employed, for as v (expression 5) is necessarily large in such machines and l is limited by the current to be collected, the inequality can be satisfied only by reducing L, and so the toothed construction of armature becomes inadmissible. It is possible, however, by means of a slight complication to reduce the reactance voltage to very small dimensions even in a toothed armature. The greater portion of the reactance voltage can be ascribed to the magnetic flux which passes between consecutive turns separated by a tooth. The remaining flux due to an armature coil is for the most part rendered ineffective as it is surrounded by short-circuited conductors. If, now, a short-circuited conductor be arranged to surround the tooth, the flux effective in causing sparking is reduced practically to leakage between the armature coil and this conductor—a very small amount. A suitable arrangement for effecting this is shown diagrammatically in Fig. 5. Here the armature coils $A\,A$ are connected in the usual manner with the main commutator C, at which current is collected by the brushes D. An auxiliary winding $B\,B\,B\,B$ passes about each tooth and is connected with an auxiliary commutator $E\,E$ as shown, where it is short-circuited by the brushes $F\,F$ at the time that the short-circuit by the main collecting brushes is being opened.[6]

The arrangement described above may be said to separate

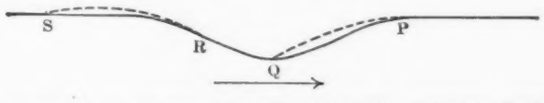


Fig. 4—Flat on Commutator (Exaggerated), Showing Path of Jumping Brush.

the functions of current collection and spark suppression instead of combining them at one commutator. For the reversal of the armature current the effective inductance is reduced to a small fraction of its value when unassisted by the auxiliary winding (less than 10 per cent in an actual case calculated), and accordingly the brushes are able to collect the current sparklessly. At the auxiliary commutator the current to be dealt with is small, being only the defect from complete reversal by the commutating field transferred by induction to the auxiliary winding. Being in a neutral field, there is of course no power behind this current. The effective inductance of the auxiliary coil is

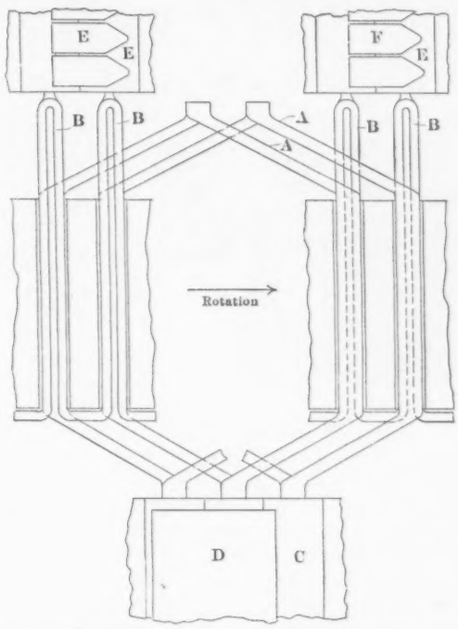


Fig. 5—Arrangement for Reducing Reactance Voltage.

approximately one-half that of the unassisted main coil,[7] while the peripheral velocity (v) of the commutator will probably not exceed one-half that of the main commutator and the axial length (b) of a row of brushes need not exceed one-half that of a row of collecting brushes. There is, therefore, not likely to be difficulty about satisfying expression (5) at the auxiliary commutator, especially as the brushes can be chosen particularly in view of their value in suppressing sparking, their current-collecting properties not being required. Moreover, to render natural commutation entirely practicable, the toe of the brush can be serrated, which, as shown in the former article, leads to this desirable consummation.

CURRENT FORMS IN THE COILS OF A SYNCHRONOUS CONVERTER.

By J. H. Morecroft.

A GREAT deal has been written on the question of the current distribution in the various coils of a synchronous converter, but so far as the writer knows no experimental results have been obtained to verify the theoretical treatment. Of course, the theory is sound and complete and really does not require experimental proof, but to the student who is not yet adept in the handling of alternating-current theory and skilled at drawing proper conclusions an experimental demonstration of the idea involved is always very helpful.

It was with the idea of obtaining this experimental demonstration that the task of photographing the current forms in the different coils of a small rotary was undertaken. Unfortunately the only machine available had a thirty-two-section armature winding placed in sixteen slots so that it was not possible to run the test three-phase. The results given in the accompanying plates were obtained when running the machine as a single-phase converter.

[6] This is practically the same as an arrangement devised by Armistead for this purpose. See British Patent No. 5146, 1904.

[7] See *Electrical World*, March 31, 1910.

The machine used was a small 220-volt, two pole, ring-wound motor equipped with two narrow rings mounted on the inside and outside ends of the commutator but insulated therefrom. These rings were connected to two points of the armature winding 180 deg. apart and served to carry the power to the windings. On the center part of the commutator the direct-current brushes made contact. On the end of the armature shaft opposite to the commutator were mounted two small insulated rings which by suitable taps could be connected across any one of a series of resistances which had been inserted in the different coils of the winding. The brush-bearings on these two rings were connected to the oscillograph vibrator.

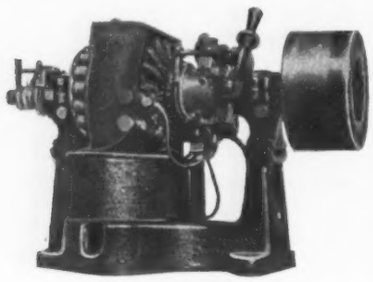


Fig. 1—Test Motor.

A photograph of the machine used is given in Fig. 1, which shows the brush rigging and the spools of resistance wire mounted on the end plate of the armature. The resistors (of approximately 1 ohm resistance each) were put in only sixteen of the coils. The current forms of only eight of these coils are given here, as of course the other eight would be duplicates of those given. The coils were numbered consecutively, coil No. 1 being next to one of the alternating-current taps and coil No. 8 being adjacent to the opposite alternating-current tap. Figs. 3, 4, 5 and 6 give the current forms in these eight coils. When they were observed the machine was carrying its full load of 4 amps at 240 volts. All of the curves in Figs. 3, 4, 5 and 6 are to the same scale.

It is a well-known fact that in a polyphase synchronous converter the armature reaction is a constant factor (that is, not pulsating) and that the current output from the direct-current end is constant and not a pulsating quantity. This is not true of the single-phase converter. There is a pulsating armature reaction in such a machine, and the field is thereby made to pulsate, with the result that the emf on the direct-current end, and hence the current output, is non-uniform. This idea is well brought out by the curves of Fig. 2, which gives the current input, *A*, and the current output, *B*, to the same scale.

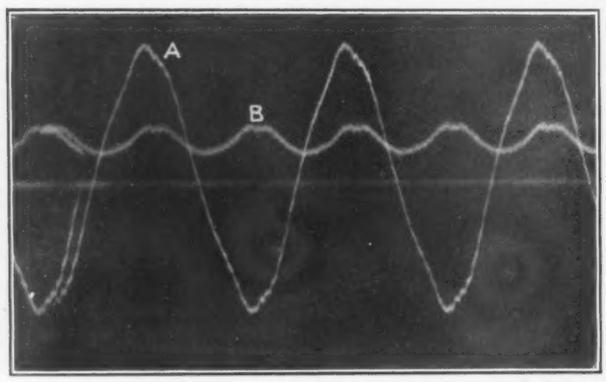
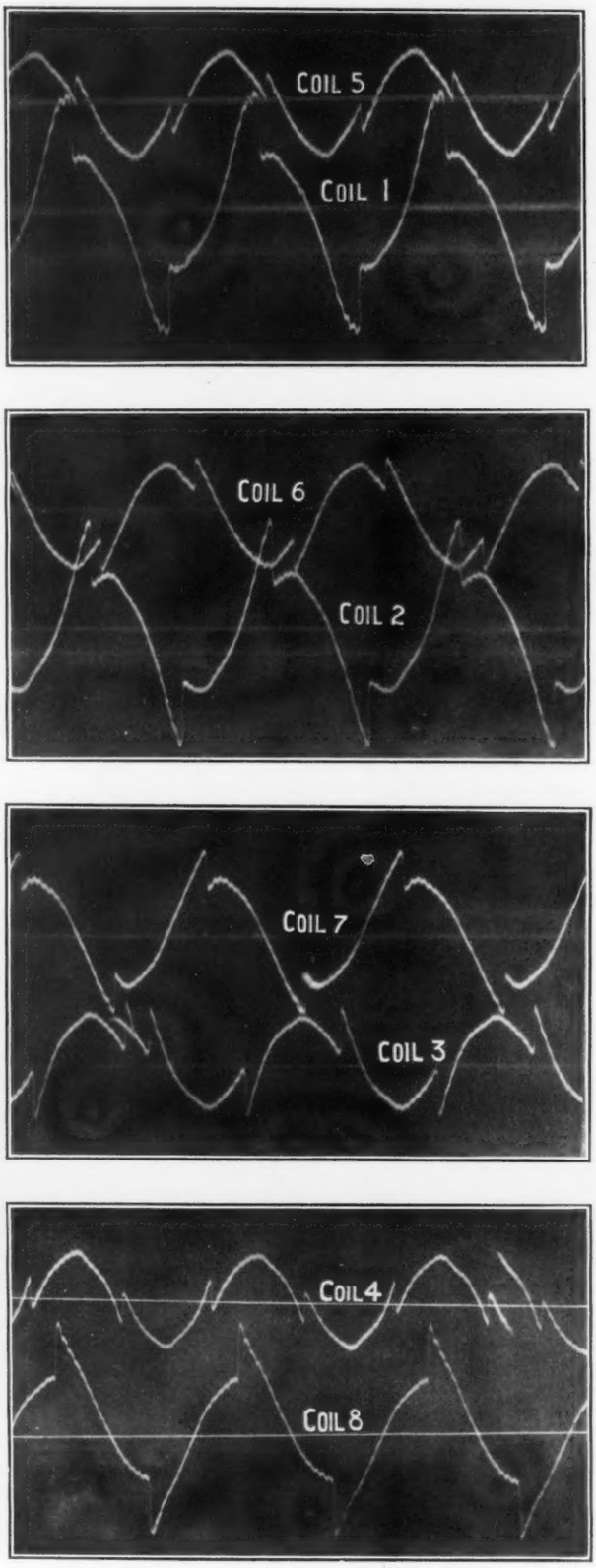


Fig. 2—Curves Showing Alternating-Current Input and Non-Uniform Direct-Current Output of a Single-Phase Converter.

If the machine had 100 per cent efficiency, the average value of the direct-current output should equal one-half of the maximum alternating-current input. It is evident that this is not the case. The rather large discrepancy is due to the low efficiency of the machine. In spite of the fact that the direct current is pulsating and that the machine used had a low efficiency, the current forms obtained from the different coils of the armature are strikingly similar to the curves obtained by combining the theoretical rectangular direct-current output with the sine-curve current input.



Figs. 3, 4, 5 and 6—Current Forms in Eight Coils.

The machine serves also for studying the current in a coil while undergoing commutation, and some very interesting curves have been obtained to illustrate this point.

Central Station
Management, Policies and Commercial Methods

WHOLESALE ENERGY DISTRIBUTION IN COLORADO

The Northern Colorado Power Company is extending its plan of wholesaling energy to small local distribution companies, the latter securing franchises and handling retail sales and collections. By this means the power company secures the advantage of considerable load which can be ultimately brought by proper combination with irrigational development to a reasonable all-day load-factor. The constant warfare against the large corporation is avoided and pleasant relations with the public are maintained. In an attempt to retain a retail business in Longmont against a proposed municipal plant the load of the company at this point was practically lost to a less economical and reliable plant, purely owing to municipal agitators.

A MOTOR LOAD IN A CEMETERY.

Even the most optimistic of contract agents, exercising his imagination to find latent new business in unpromising fields, would hardly view a cemetery as a prospective motor customer. However, the Pueblo (Col.) Traction & Lighting Company now supplies a very desirable 40-hp motor load in one of the local burying grounds where two 20-hp pump units are installed to irrigate and sprinkle the 50 acres of lawns. Pueblo is in a dry country where the rainfall alone is not sufficient to grow crops, or even grass, without irrigation or artificial watering. The cemetery pumps are set in a concrete underground vault, from which radiate the pipe lines to sprinkler and hose outlets in all parts of the grounds. The motors are controlled entirely from the superintendent's office, the touch of a button being all that is required to water a given section of the lawns. These new motor-driven pumps are, of course, perfectly silent in operation, in marked contrast to the gas-engine-driven pumps first used there without success. The motor units are placed out of sight underground and their operation would not disturb funeral ceremonies held within a few feet of the concrete pump vault. Incidentally, by pumping its own water supply the cemetery management is netting a substantial saving over the cost of buying water from the city.

GETTING CUSTOMERS ACQUAINTED WITH THE PLANT.

Few customers fully realize the complexity of central-station service, the investment in plant and equipment, the size of the coal pile, the number of men employed about the station and the precautions taken to insure continuous operation of the machines so that there shall be no interruption of twenty-four-hour service. The consumer who has once visited the plant, even for a casual inspection, quickly comes to realize that running an electric company is serious, hard work, and he is likely to be less irritable over a slightly increased bill and less impatient over a short interruption to his service.

Mr. J. E. Johnson, manager of the Stamford Gas & Electric Company, of Stamford, Tex., makes a point of encouraging his customers to visit the generating station often and see how their electrical energy is produced. While visitors are always welcome at the station, a special occasion is made of New Year's Eve, when from 500 to 600 invitations to be present at a watch party at the plant are sent according to a selected mailing list. After the guests have inspected the machines, boilers, etc., refreshments are served. The cost of the engraved invitations, ice cream and cake, etc., runs from $50 to $75 each year, but Mr. Johnson considers this a good investment in view of the large number of visitors to the station and the sentiment created. Several hundred people usually attend these power-plant watch parties, including in the number a large number of prospective users of electricity. Mr. Johnson makes another point of maintaining his plant and equipment in the best possible condition, and at the time of the plant parties has his men dressed in neat uniforms. These watch-night receptions have been held with successful results at Stamford during several years.

ELECTRICITY TO THE RESCUE IN GAS-COOKING DEMONSTRATIONS.

Fifteen hundred of the leading women of Oklahoma City, Okla., have taken a lively interest in the cooking lectures recently given in that city by Mrs. Helen Armstrong under the auspices of the *Daily Oklahoman*. Natural gas is generally used for cooking in Oklahoma City, and the demonstrations were given with gas ranges. On the final day of the course, however, when it was planned to finish up with a grand demonstration of "paper-bag" cookery, the natural gas main broke 90 miles out of town, and for twenty-four hours all the gas ranges remained cold. Mr. Robert C. Leonard, sales agent for the local central station, had already placed an exhibit of electric cooking devices in a booth in the lecture hall, for the inspection of women attending the meetings, and when the "S. O. S." call came from the woman demonstrator who faced an audience of 1500 waiting housewives with nothing to illustrate her culinary precepts, Mr. Leonard promptly offered her a Copeman electric fireless-cooker range which was on exhibition. This assistance was gladly accepted, and the last and most important lesson of the course was triumphantly completed with the aid of electric heat. Many of the women in the audience were quite taken with the electric-cooking idea, and as the result of the single incident the use of electric devices in Oklahoma City received quite a boost.

The interruption of the gas supply for even a short time worked considerable hardship in the homes of the city, although those housewives who were provided with electric appliances were able to prepare emergency luncheons. One consumer reports going home to find his wife cooking vegetables and meat and boiling coffee on an upturned electric flatiron, transferring each dish as done to an electric heating pad, which kept it warm until ready to serve.

CREATING REAL-ESTATE VALUES WITH ELECTRIC LIGHT.

A new office building erected in an Ohio city several years ago proved difficult to fill with tenants. Although in the best part of the downtown section, the tide of traffic passed on the other side of the street and for several months the new storerooms and offices stood idle. About this time the central-station company was moving its offices, and its contract manager suggested that his new-business department be allowed to occupy the empty corner with a

showroom for a few months. He offered to outline the lower two stories of the building over the showroom with tungsten sign lamps and explained that the use made of the rooms for demonstration purposes would in no way injure the walls or change the layout of the floor space. On the other hand, he pointed out, the brilliant display would attract pedestrians and soon make this side of the street as popular as the other. These arguments appealed to the owner, who recognized that he had nothing to lose beyond the rental of his already empty storeroom, and he agreed.

Several hundred tungsten lamps outlining the lower part of the building soon made that sidewalk the brightest stretch of illumination in the city. The showroom interior was rendered handsome and attractive with lighting fixtures and appliances. Special care was given to the window displays. The company had been paying some attention to farm service, and an appropriate exhibit with some live pigs attracted crowds. Later a poultry display, with an electric incubator on one side and an electric oven on the other, was made and labeled "Electric from Start to Finish." The public became interested in this showroom, and that corner never afterward lacked for popularity. Tenants soon began to fill the offices upstairs and adjoining the showrooms, and two months later, as the result of a flattering offer from a far-sighted merchant, the corner room itself was rented at a good figure and the new-business department had to move out. Its gain, however, was sixty days' use of one of the best corners in the city at practically no expense, while the building owner profited from the conversion of an idle building into a good investment.

BILLING AND RECEIPTING WITH POST CARDS.

The Topeka Edison Company makes use of a post card form for billing and receipting customers. Attached as a part of the original card before it is sent out is the customer's stub, which is removed after being filled in and is kept at the cashier's desk until the bill is paid. The customer's name appears only on the address side of the post card, the back being occupied with the items of the statement. If the customer brings in his bill and pays in person, the stub is first referred to to check errors, and the statement is receipted on its face. If payment is sent in by mail, the card has only to be receipted and a new stamp affixed, the original address sufficing to return the card to its destination and so saving considerable office work. On the left half of the address side of the card is printed a full statement of the rates for service, so that the customer can refer to the schedule if in doubt as to the correctness of his bill.

NO DISCOUNT AFTER MAY 10TH

PLEASE BRING BILL WITH YOU. SAVE TIME.

PARTY ADDRESSED ON OPPOSITE SIDE

To THE TOPEKA EDISON CO., Dr. TOPEKA, KANSAS.

STATEMENT OF METER:

Apr. ....., 1912 .....

Mar. ....., 1912 .....

Difference ..... X .....

K. W. Hours ..... @ ..... ¢ Gross. - $.....

Discount, $.....

Net, - $.....

Delinquent, $.....

$.....

CUSTOMER'S CREDIT COUPON. T. E. CO.

Date Paid MO. APR. 1912.

Gross $.....

Dis. $.....

Net $.....

Delinq. $.....

Cash $.....

Post-Card Form for Billing and Receipting.

THE METER-DIAL PAPER WEIGHT.

On the counter in the office of the Amarillo (Tex.) central station a meter dial and gear train is used as a paper weight. By actual observation nine out of every ten of the customers who come in to pay bills or make complaints pick up this dial and toy with it while waiting or transacting their business. No better illustration could be given of the simplicity of meter parts, and the consumer who grasps for the first time the elementary mechanism behind the white enameled surface departs with a new idea of the simplicity of the whole instrument. The little dial is also used to show customers how to read meters, as well as to illustrate how errors may be made by the unpractised when the pointers are in certain positions.

SALES CREDIT SCHEDULE FOR SOLICITORS

In most new-business organizations complete reports are made up each month of the sales closed by each solicitor during the preceding thirty days. The methods used in compiling some of these reports, however, are not exactly fair to the solicitors, where they draw no distinction between the ordinary contract for service which would naturally drift into the office and those more difficult contracts the securing of which calls for genuine salesmanship. Where such a practice has been in vogue for some time there may result a tendency for the solicitors to look about for the "easy" business, neglecting the class of contracts for which the new-business department is intended.

To encourage the class of business for which the solicitor must work hardest, and incidentally to encourage the spirit of friendly rivalry between solicitors, Mr. R. C. Leonard, acting new-business manager of the Oklahoma Gas & Electric Company, Oklahoma City, has instituted the system about to be described for keeping a record of the work secured during each month. Credit points are reckoned as follows: Transfer, 2 points; addition, 5 points; contract, 5 points; electrical contract displacing gas, gasoline, oil or acetylene, 15 points; gas contract displacing other fuel, 15 points; piping or wiring old houses, 15 points; electric sign, 20 points, with one point additional for each ten lamps or majority fraction thereof; highest kw load connected during month, 30 points.

Mr. Leonard reports that this system of keeping records has more than met his best expectations in encouraging the solicitors to obtain the business that is hard to secure. During the seven weeks this system has been in operation the three solicitors, in addition to the business which would

naturally have come into the office and to work caused by extensions, have succeeded in having ninety-nine old houses either wired or piped, and have secured one hundred contracts for displacing other forms of service. This has been absolutely without any additional cost to the company in the way of special advertising or campaigning.

The solicitors watch with great interest the comparative figures showing their records from day to day. At a moment's glance any one can determine the actual standing of each man, so that this gives a splendid basis for promotion. The system is also very flexible. For example, by attaching the proper number of credit points to the various classes of business, the manager can encourage any particular business as it sees fit.

VOUCHER SYSTEM OF BOOKKEEPING FOR CENTRAL STATIONS.

On account of its accuracy and simplicity of application, the voucher system of bookkeeping is especially adapted to the needs of the small central station, said Mr. C. G. Edwards, of Albert Lea, Minn., in discussing the subject of accounting before the Minnesota Electrical Association.

The books in use with this system at Albert Lea, as described by Mr. Edwards, comprise a two-column ledger, a cash book, customers' ledger, voucher register, meter readers' books and stock ledger, besides which are kept meter and transformer records and engineers' daily reports. The last-named consist of steam, voltage and water charts and half-hourly switchboard meter readings, and are footed and averaged daily by the office staff, keeping the management in close touch with plant operation.

The customers' ledger is ruled to take care of twelve months' business, the names being alphabetically arranged and each page providing for about thirty customers, entered on consecutively numbered lines. Each customer therefore has a page and line number, which is borne by all statements, making it easy to enter and refer to accounts. Following the customer's name and street number, the page is divided into twelve columns, headed "January," "February," etc., and each column is subdivided as follows: "Balance Forward," "Electric Light," "Power," "Merchandise," "Rebates and Discounts," "Amount Paid," and "Date When Paid."

After the bills have been made out from the meter readings taken from the meter books, they are entered under the proper columns in the customers' ledger, and then, as paid, the amount is entered under "Amount Paid," the amount of discount being entered under "Discounts." The form of customer's statement recently adopted at Albert Lea includes the entire monthly account in one statement, showing not only the current month's meter readings, with places for both light and power readings, gross amounts and discounts, but also the customer's balance on the company's books, keeping him posted monthly as to whether he has obtained proper credit for amounts previously paid and so giving him a complete statement.

Itemized merchandise and other statements are made out on separate bills, attached to the main statement, on whose face only the total amounts are entered. The reverse side of the statement carries the company's rules and rates. While this statement has been in use but a short time, it has not only lightened billing work but has been the cause of many favorable comments from customers.

As nearly as possible, all meters are read on the same day each month. When customers are not found at home return postal cards are left requesting them to mark on the printed dials the positions of the hands on their meters. This plan is found to save much time in going back over the meter routes.

Shortly after the first day of each month the columns of the customers' ledger are added, giving the total amount of sales, discounts and receipts for the preceding month, outside of cash merchandise sales, of which a separate blotter is kept. These accounts are then transferred to their proper place on journal entry blanks for entry in the ledger.

As all items in the ledger are total and as there occur various items during the month for ledger entry, a journal entry blank is used, ruled with debit and credit columns in which the items are entered, and they can then be totaled for entry in the ledger.

The journal entry covering totals from the customers' ledger would therefore be headed as to sales:

Dr.	Accounts Receivable.	Cr.	Light Sales Power Sales. Mdse. Sales.

Discounts would be entered as a credit to "accounts receivable," and the "total paid" as a debit to "cash" and as a credit to "accounts receivable."

All outstanding bills against the company are each month inclosed in vouchers, or classification blanks, ruled on one side so that there can be "written in" all items of the statement in case the latter should become detached from the voucher. On the other side, besides the headings "To Whom Issued," "Month," "Total Amount," "Check No." and "Bank," there is a heading "Classification," under which is entered the heading of the account in the voucher register under which it is to be entered.

Attached to this voucher is fastened not only the statement itself as received, but also all shipping bills and any other matter pertaining to it, thus making of it a complete record of the transaction.

The voucher register in which these vouchers are now entered, and which is the book of record of all invoices that have been first approved by the management, is ruled thus:

To Whom Issued..... Number of Voucher..... Total Amount..... Date Paid.....
General Expense Account—Salaries, Rent, Insurance, Taxes, Office Expense, General Expense, Soliciting New Business, Advertising, Commissions.
Operating Account—Engine Room, Boiler Room.
Operating Maintenance—Workshop Supplies and Expenses, Miscellaneous Station Expense, Repairs to Engines, Dynamos, Boilers, Belts and Shafting, Pumps and Blowers, Piping, Electrical Apparatus.
Distribution Accounts—Incandescent Lamp Renewals, Arc-Lamp Expense, Meter Expenses, Carbons, Transformer Repairs, Pole Line Repairs, Curb Light Expense.
Property and Construction Accounts—Furniture and Fixtures, Steam Machinery, Electrical Apparatus, Electrical Conductors, Meters, Transformers, Arc Lamps, Belts and Shafting, Steam, Water and Blast, Piping, Tools and Implements, Installation, Curb Light Construction, Hot-Water Construction, Merchandise in Stock.

About the tenth of the month, at the same time the customers' ledger is footed, and after all accounts are collected, vouchered, classified and entered under their proper headings in the voucher register, the latter register is totaled, and by means of journal entry blanks the totals are made ready to put under proper ledger accounts.

The total amount of voucher register is now entered as a credit under "accounts payable." Entering as a debit the amount from the cash book of vouchers paid during the month gives as the difference the amount owed.

Cash merchandise sales are carried separately, being footed at the end of the month and by means of a journal entry credited to "merchandise in stock" and debited under "accounts receivable."

From the balances now at hand from the customers' ledger, voucher register, cash book and journal entries the monthly statement is then made up. This presents not only a trial balance, but is also made a comparative statement of the current month and the same month the year before, the total business of the year to date being also compared with the same number of months of the previous year.

For footing accounts, as well as footing engineers' reports and work of that character, use is made of an adding machine in conjunction with a cash register. This gives not only totals of the days' and months' business but receipts the customers' statement, giving the number of the clerk giving the receipt, the date, amount and for what paid, reducing office work to a minimum.

Wiring and Illumination

HOUSTON'S OVERHEAD UNDERGROUND CABLES.

The underground feeders leaving the generating station of the Houston (Tex.) Lighting & Power Company are carried for a distance of 240 ft. over a reinforced-concrete bridge structure spanning a ravine near the plant. The run comprises forty-nine 3¼-in. Camp ducts, laid seven

Underground-Cable Ducts at Houston, Tex., Carried on Concrete Piers.

wide and seven high, and rests on a continuous reinforced-concrete beam supported at 16-ft. intervals by fifteen concrete piers. Several of these piers are from 20 ft. to 25 ft. in height. The floor beam is 5 in. thick at the piers and is increased to 8 in. at the span centers, obtaining truss strengthening by putting the reinforcing steel in tension. On its sides and bottom the duct run is covered with a 4-in. concrete coating as shown. From the tops of the banks on each side of the ravine concrete manholes open into the cable ducts. This unique bit of "overhead underground" construction has caused interested comment among engineering visitors to the Houston company's plant and illustrates a method of handling subway structures where these must perforce rise above the surface for a short distance.

INSULATING AND SUPPORTING FIXTURES.

By R. H. Cronin.

Insulating joints are used to insulate fixtures from grounded parts of a building. The wiring spaces within fixtures are so confined that grounds are very liable to occur in them. If the fixture is insulated from the grounded

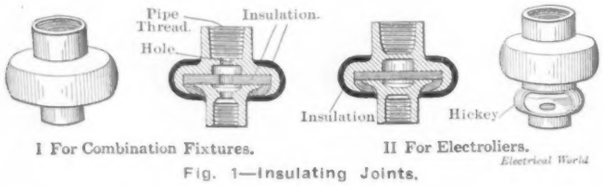


Fig. 1—Insulating Joints.

parts, one ground within it is not liable to do harm. Fig. 1 shows some insulating joints. That at I is used for combination gas and electric fixtures. It has a hole through it to permit the passage of gas. That shown at II is for electroliers and has no hole through it.

In insulating combination fixtures the insulating joint should be located as near as feasible to the ceiling, and the wire ends left after connecting should never be twisted around the supporting pipe above the joint. (See Fig. 2.) Flexible tubing is required on the wires in knob and tube work and it should extend below the joint. The code requires that the pipe above the joint be protected with in-

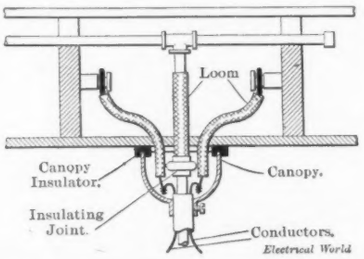


Fig. 2—Insulating Joint for a Combination Fixture.

sulating tubing, which may be either a heavy wrapping of tape or circular loom.

Fixtures can be supported in frame buildings by the method of Fig. 3. A wooden strip or cleat should be fastened just above the lath during the construction of the

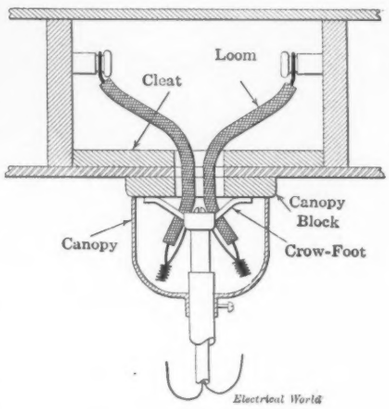


Fig. 3—Electric Fixture Support.

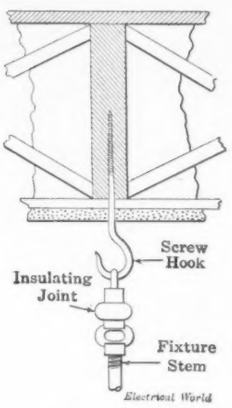


Fig. 4—Support for a Heavy Fixture.

building to take the screws to hold a canopy block. The wooden canopy block supports, with wooden screws, the fixture crowfoot and insulates the canopy from the ceiling. A screw hook turning into a joist (Fig. 4) can be used for sustaining heavy fixtures in frame buildings. A special

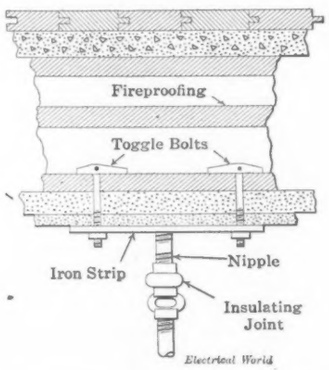


Fig. 5—Support from a Fireproof Ceiling.

insulating joint having an eye is inserted in the fixture stem to insulate the fixture from the ceiling, or a chandelier loop can be used on a regular insulating joint. In fireproof buildings where fixtures must be erected after the building is completed an iron strap (Fig. 5) held to the surface of the ceiling with a couple of toggle bolts can

be utilized for supporting a fixture. A pipe or conduit nipple turning into a threaded hole in the strap takes the weight of the fixture.

Fixture canopies can be insulated from ceilings and walls with commercial canopy insulators, of which there are many forms on the market. Canopies are usually supplied

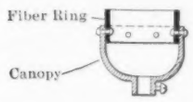


Fig. 6—Fiber-Ring Insulator.

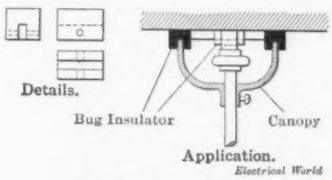


Fig. 7—Bug Insulator.

Electrical World

already fitted with insulating rings by the fixture manufacturers. Where canopy insulators must be "homemade" the method of Fig. 6 or that of Fig. 7 may be followed. In Fig. 6 a ring of fiber formed from the sheet material is bent to fit the interior of the canopy and is held therein with wires or small rivets. The ring should extend about 3/8 in. above the top edge of the canopy. Another canopy insulator, sometimes termed a "bug" insulator, can be sawed from block fiber, as shown in Fig. 7. The upper edge of the canopy rests in a slot sawed in the "bug." At least three such insulators should be used for every canopy. A small nail or wire driven through a hole in the insulator and one in the canopy holds each "bug" in position.

LIGHTING LARGE ASSEMBLY ROOMS.

By Albert Scheible.

While much has been written as to the choice and design of lighting units for use in particular instances where assembly rooms were to be lighted, the general problems involved by such halls have not often been treated in their broader aspects. It is, therefore, doubly pleasing to note the way in which this question of assembly-room lighting was presented before the recent International Congress for Indoor Hygiene at Dresden by Director Meng of the local city electric light works. Instead of trying to map out the lighting methods suitable for different arrangements of halls, the speaker endeavored to set up a series of ideals toward which the lighting should aim, regardless of the illuminant employed.

These ideals, presented in the form of seven rules or tenets, serve so admirably as standards for comparing the advantages and disadvantages of gas and electricity that they deserve both a wide publicity and a cheerful study on the part of all interested in hygienic lighting. Indeed, a proper scrutiny of Director Meng's tenets may emphasize some of the distinctions between gas lighting and electric lighting which ought to be more widely known, as in the case of his first general rule: (1) "The illumination shall be such as to give a highly diffused light, avoiding both bright areas and dark spots."

With the older methods, in which most of the lighting was effected by direct rays from the lamp and in which a comparatively small portion of the light was diffused and redistributed by the walls and ceilings, gas burners complied with this rule about as well as incandescent electric lamps. However, the indirect and semi-indirect lighting methods which have gained in vogue during the past few years have shifted the balance in favor of the distribution from walls and ceilings, thereby making it imperative that these should be kept free from dust, soot or other deposits. The introduction of enameled steel ceiling plates over gas-light units and the persistence with which some gas companies have been arguing against the use of indirect lighting fixtures imply that gas lamps are at a disadvantage in this regard. Incidentally, attention is also called to the part which the deposits of dust or soot play in marring the beauty of walls and ceilings. To guard against such disfiguration it might be well to add a new tenet: "The lighting shall not soil the walls and ceilings, nor shall it interfere with the artistic effects obtained by the coloring or gilding of the same."

The second and third rules laid down by Director Meng seem to be equally well met by Welsbach burners and tungsten lamps: (2) "The illumination, except in so far as it relates to festival or decorative lighting, shall not be more intense than necessary, in order that it shall not tax eyes which already have been tired by daylight." (3) "But the illumination shall be of such intensity that a normal eye can clearly discern the objects in the room even at the distances occurring in the same."

However, it is only when judged by these two tenets (out of seven or more) that gas stands on a par, for the experienced German continues: (4) "The lighting shall avoid all glare; particularly shall there be no separate points of light at the height of the common or necessary line of view to make a persistent impression on the same point of the retina of the eye."

Here we immediately strike the difference, as gas lamps are not easily controlled when placed beyond the reach of a person standing on the ground. Consequently, part of the gas lamps used in assembly rooms are usually placed within the line of vision, while allowing the corresponding lamps to be installed at any desired distance from the controlling switches—a distinction pointed out by Herr Meng himself in his fifth rule: (5) "The lighting shall be easily turned on and off, both in whole or in part."

The sixth precept touches a point which the gas advocates have often tried to get around, but which persists in presenting itself: (6) "The lighting shall neither pollute nor overheat the air of the assembly room." That any heat generated by the lamps is particularly undesirable in a crowded room where the body warmth of those present already increases the temperature of the room should hardly permit of argument. Of course, the heat of the lamps, or at least a portion of it, can sometimes be used for causing a suction in special flues and therefore improving the ventilation. But whether such a special ventilation really justifies the air deterioration which makes it necessary is another question, it being doubtful if the best results can be obtained by making the ventilation partly a function of the lighting, or whether the plans for proper lighting should involve an added outlay for ventilating ducts. In view of recent tendencies in gas lighting, this sixth requirement might be improved by adding: "Nor shall the lighting require a special ventilating system to overcome its effect on the air of the room."

The last of the seven German tenets is also interesting: (7) "The illumination shall be free from fluctuations in the intensity of the lighting, as free as possible from disturbances, and without danger for those in the assembly room."

In years gone by, when voltages often showed a 5 per cent variation during the course of an evening, and when the protection of circuits against outages by lightning or grounds was very crude, the first two parts of this rule could not have been met by many electric-light circuits. But that day is over, and in nearly all central-station practice the voltage fluctuation (and the corresponding change in candle-power of the lamps) is negligible compared with the flickering of gas lamps due to the great variations in gas pressure at various times of the day and evening. The other part of the rule, namely, that referring to the endangering of human life, would rarely come into play in assembly rooms, although it is conceivable that the gas supply might be turned off and on while the room was occupied and that a serious explosion might occur in the endeavor to light it

again. But by far the greater danger is met in dwellings, where a blowing out of the gas by drafts from open windows is not uncommon and where such an extinguishing of the gas may easily lead to asphyxiation as well as explosions.

All told, the requirements laid down by Director Meng offer an effective method of showing how fundamentally superior electricity is to gas for indoor lighting, and perhaps it is high time for the electrical fraternity to acquaint the general public with such simple rules for comparing the desirability of lighting systems.

RECENT TELEPHONE PATENTS.

DISPATCH APPARATUS.

Where telephone dispatching is in use with selective calling apparatus the way stations are usually called individually. It may, however, be desirable to signal all simultaneously. This is the case if it is desired to send out over the line standard time signals so that all clocks may be adjusted. A bridging signal responsive to reversed impulses will serve the purpose and may be caused to follow the impulses in such a way as to reproduce observatory time signals. This is the method used in a system providing this feature patented by Mr. E. R. Gill, of Yonkers, N. Y.

A second patent granted to this same inventor describes a dispatch circuit system. The telegraph and selector control relays are included in series with the line. The line is grounded at each end through a retardation coil. Each relay is bridged by a high non-inductive resistance and a condenser. The telephone apparatus proper is connected only during actual conversation. It is legged off to ground whenever the hook switch rises to its top limit. Telephone conversation is, therefore, over a grounded circuit.

The patent granted to Mr. S. L. Van Akin, Jr., of Liverpool, N. Y., describes a set of instruments designed for a dispatch line. An L-shaped tube is mounted so that it may swing about a vertical axis through its short arm. The end of the long arm carries a second tubular arm, to the top of which the receiver is connected and to the lower end of which the transmitter is connected. The short arm swings about a horizontal axis near the transmitter. The wiring is concealed within the tubes at the base of the vertical arm. Where the set is arranged to swing, an arrangement of rings and brushes is provided so as to avoid any twisting of the conductors. This also provides for switching the circuits as the arm is swung from the normal mid position to the position of use.

Letters to the Editors

DIGGING POST HOLES WITH DYNAMITE.

To the Editors of Electrical World:

Sirs:—In reference to the report in your issue of June 8 on the digging of post holes with dynamite in Marion, Ind., it may be of interest that a very similar method was used by the writer as far back as the summer of 1902 for pole holes on the grounds of the Virginia Polytechnic Institute.

The process used was to open the top of the hole about a foot deep with a round-point shovel and drive a steel rod down to within about 6 in. of the desired depth of hole, pull out the rod, put in a stick of dynamite and tamp the hole with clay or fill with sand. The result on firing the charge was all that could be desired, usually blowing the earth entirely out of the hole in the shape of a plug which fell to pieces around the hole.

It was found to be good practice to measure from the top of the ground to the top of the cartridge, remembering the distance, so that in case of failure to fire the rod could be driven down to within about 6 in. of the cartridge and a "pop" shot, about one-fourth of a stick of dynamite, used to fire it on second trial. This method proved satisfactory in putting holes through pavements of various kinds as well as ordinary earth. Five-foot holes were the rule with us, and the earth was usually a stiff clay with about a foot of loam on top. For deeper holes, 7 ft. to 8 ft., the top was excavated for from 1.5 ft. to 2 ft., the results being satisfactory.

With the cartridge well tamped no "spooning" was necessary. Often a "borrow" had to be dug to obtain earth to tamp the pole. It was found that poles set in dynamited holes stood up better than those set in holes dug in the usual manner, probably because the explosion compacted the earth. The experience of the writer indicates even lower cost results than those reported in your recent issue.

Blacksburg, Va. Claudius Lee.

INDUCTION MOTOR WIRING.

To the Editors of Electrical World:

Sirs:—I was very much interested in an article in your issue of May 25 under the heading of "Induction Motor Wiring," stating the sizes of wire which are necessary for the different sizes of motors of 220 volts and 440 volts. This is a point on which I believe all people with the exception of the boards of fire underwriters and wire manufacturers feel pretty strongly. The idea of putting in a cable which is several times as large as is required to carry the current, adding to the cost of the motor this extra investment, which in a great many cases exceeds the cost of the motor, always seems to me not only downright foolishness but in a great many cases out-and-out robbery. The case cited in which No. 4-0 cable is used on a 100-hp, 440-volt, three-phase motor is a good case in point. The actual current that this machine will use as an average will be under 100 amp per wire. If the wire is inclosed in conduit so as to keep the heat in it as much as possible, there will be a temperature rise in the wire of approximately ¼ deg. Fahr., which I think will in no wise harm it to such an extent that it will deteriorate before more wire can be manufactured. The fact that from the nature of an induction motor a considerable amount of current has to be used in starting—a current which if continued for any length of time would burn the motor up—is no reason that I can see why the wiring should be made of such size that it will carry this overload continuously.

In order to get back to the case of the 100-hp motor again, the circuit will pass in this particular case from a No. 4-0 cable, which can carry safely 325 amp according to the underwriters and when carrying 325 amp has a temperature rise so small that it cannot be detected, to a No. 6 wire in the machine itself. Now, it may be that a No. 4-0 cable stretched in insulators, or as is usually done in iron conduit, is a much greater hazard than the No. 6 wire carrying the same current in a motor which is generally oil-soaked and subject to no protection whatever from the outside; but, at least, we are led to believe that from a common sense point of view this supposition is "tommyrot." The whole thing is as inconsistent as it would be to lead a pup with a log chain.

I should be very glad indeed to have the views of others on this proposition and to learn just why it is that such inconsistencies as this continue to be the standing joke of the electrical industry and force the electric motor user to pay for wiring which is in no way better or safer than wiring which can be supplied at a very much less cost.

Cleveland, Ohio. J. F. Lincoln.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commutation.—D. ROBERTSON.—After describing the methods already in use, the author explains a way in which the oscillograph can be applied to show the internal currents in an armature without cutting one of the main coils. Records are given illustrating various points about commutation. He also urges the insertion of the indicating coil during construction as a matter of course in all large machines or those working near the limits of good commutation.—London *Electrician*, June 7, 1912.

Characteristic Curves of Synchronous Motors.—K. SIMONS.—The author shows how the characteristic curves of synchronous motors may be plotted in a very simple way by making use of Reuschle's signation method (signierungsprinzip). The feature of this method is to determine the portions of the area on which the curves are to be plotted on which points of the desired curve cannot be situated. These impossible districts are found by taking into consideration the sign of the coefficients of the equations of the curve. This method, together with the determination of the asymptotes and of a few points of the curve, gives the whole curves with a high degree of accuracy.—*Elek. Zeit.*, May 30, 1912.

Lamps and Lighting.

Changes in Metallic Filaments During Use.—F. J. BRISLEE.—An illustrated description of an investigation of the microstructure of metallic filaments and the changes which they undergo while incandescent. Illustrations of the structure before use and after use are given, and it is shown that after use both drawn and extruded (sintered) filaments become entirely crystalline and there seems to be practically no difference in strength between the two. On purely theoretical grounds the advantage of a drawn filament over an extruded one is the rate at which the crystallization will take place in the two wires. It has been shown that the rate of crystallization depends upon the size of the crystallization nuclei; hence the drawn filament, having smaller crystallization nuclei, should crystallize more slowly than an extruded filament which has relatively large nuclei. Further, it may be that traces of gases are given off during the running of the lamp, and this may accelerate the changes, the gas acting as a catalyst, or they may be due to the alternate formation and decomposition of a compound between the gas and metal. When the crystallization has once taken place there seems to be no difference in strength between the drawn and the extruded filaments. The possible net gains in favor of the drawn filaments are increased strength of wire, which assists in manufacture and reduces breakages during handling and transit, and the longer time required for the drawn filament to reach the extremely brittle crystalline state. This latter gain does not seem to be obtained, at any rate on alternating-current circuits. The reason for this is not evident, and for its elucidation further investigation is required.—London *Electrician*, May 31, 1912.

Condensers in Series with Metallic-Filament Lamps.—A. W. ASHTON.—A paper read before the (British) Institution of Electrical Engineers. The author describes recent developments in the use of low-voltage metallic-filament lamps in series with condensers on alternating-current circuits. An important improvement has been made in the process of manufacturing condensers of tinfoil paper impregnated with paraffin, whereby the condenser is rendered much more suitable for use on lighting circuits. The new process consists essentially in the immersion of the condenser roll in melted paraffin wax after vacuum impregnation and the subjection of the wax to high mechanical pressure during the process of cooling. The pressure is from 1 ton to 2 tons per square inch, and it is important to note that while the pressure is maintained on the paraffin, the condenser itself is not pressed upon in such a manner as will flatten or otherwise distort its shape. The pressure is maintained until the paraffin is cooled and set. The author gives an account of measurements of the dielectric losses in such condensers and discusses in detail the series system and the parallel system of using condensers in connection with metallic-filament lamps, both of which have already been described in detail in the *Digest*. Certain advantages of the condenser in preventing "overshoot" and in cheapening the wiring of small houses are dealt with, and the effect on the power-factor of public supply systems of the extensive use of condensers is also considered. In the discussion which followed W. R. Rawlings thought that the condensers are too large for use for domestic purposes. A 5-mf condenser is 2.5 in. by 2.5 in. by 6 in., which is too large for ordinary applications to lamps. In his reply the author said that the size depends entirely on the factor of safety which is considered necessary. The condensers in use at present were tested at 1000 volts for use on circuits up to 250 volts. By reducing the straining emf to 500 it would be possible to reduce the dimensions to about one-quarter of their present values. It is not considered advisable, however, to reduce the factor of safety because it is realized that in order to extend the use of condensers an absolutely reliable article must be offered. He did not think the reduction of the dimensions of such importance as was assumed, as the condenser can generally be put in such a position that its dimensions are relatively unimportant.—London *Electrician*, May 24, 1912.

Disposition of Metallic Filaments in Lamp Bulbs.—A note on a recent British patent (27,388, May 23, 1912) of R. Jahoda & Elektrische Glühlampenfabrik "Watt," Scharf, Loti & Latzko. A lamp to emit light uniformly in all lateral directions as well as downwardly is made with the upper and lower arms radiating from the stem at right angles to one another. Each contains hooks for the reception of the filament. The resulting disposition of the mounted filament is as a warped surface which secures the effect sought. For winding long lengths of filament and at the same time to keep the cross-arms short, a double row of hooks may be used, when two warped surfaces are obtained.—London *Elec. Eng'ing*, May 30, 1912.

Tungsten Lamps.—An article by H. A. Hussey on series tungsten lamps for street lighting and another article by G. P. Scholl giving a review of technical advances made in the last few years in the construction of large and small tungsten lamps and of tungsten lamps for special purposes.—*Elec. Journal*, June, 1912.

Flame-Arc Lamps.—An article by W. P. Hurley and C. B. Padon on street lighting by metallic flame-arc lamps and an article by C. E. Stephens on the long-burning inclosed flame-arc lamp with diagrams of its mechanism.—*Elec. Journal*, June, 1912.

Reflectors for Street Lighting.—L. BLOCH.—An illustrated translation of his recent German paper in which the author considers the question of the most suitable shape for the reflector to be used with metallic filaments for street lighting and shows that the parabolic reflector gives the best results. The question of the most suitable height at which to suspend the lamps is also considered, and this height is shown to depend on the candle-power of the lamps in question.—London *Electrician*, May 31, 1912.

Train Lighting in Austria.—F. BACH.—An illustrated ac-

count of the results obtained with electric train lighting on the Emperor Ferdinand Northern Railroad. Electric train lighting was introduced on this road in 1892, a pure-storage battery system being first used. In 1904 this was supplemented by a mixed system with storage battery and axle-driven dynamo, the Dick single-storage battery system being employed. This is described in considerable detail.—*Elek. u. Masch.* (Vienna), May 26, 1912.

Generation, Transmission and Distribution.

Gas Versus Steam.—Some comparative figures on the cost of gas and steam-power plants, given by Carr as the mean of the cost in a large number of small and medium-size stations. The figures cover the cost of the installation, comprising both machinery and buildings, in dollars per kilowatt rating:

	Below 500 Kw.	From 500 Kw. to 1000 Kw.	From 1000 Kw. to 2000 Kw.
Steam	$275.00	$189.00	$147.40
Gas	200.00	167.00	152.40

The mean cost of operation per kw-hr. sold is 1.58 cents for municipal producer gas plants, 1.36 cents for "ordinary" producer gas plants and 2.34 cents for steam plants. These figures do not include interest, taxes, executive direction, insurance. When these are included the cost per kilowatt-hour sold is 2.6 cents for municipal producer gas plants and 3.26 cents for steam plants; the corresponding figure for "ordinary" producer gas plants is "unknown." Coal is figured at $2.52 in municipal stations.—*La Revue Elec.*, May 24, 1912.

Diesel Engine.—William J. U. Sowter.—A paper read before the Dublin section of the (British) Institution of Electrical Engineers on the Diesel engine from the user's standpoint. Although the Diesel engine has considerable advantages, first-class attention is necessary to secure reliability. The choice of a suitable grade of oil is important. Owing to the high compression which must be maintained it is necessary to keep the valves quite tight. The inter-cooler drain must be blown down at regular intervals, say every half hour, particularly in damp weather. The air-storage receivers are provided with siphons and drains and must be drained every day. Finally, the causes of defective starting are discussed, namely (1) low compression, (2) defect in oil pump or oil supply, and (3) incorrect adjustment of fuel, air or exhaust valves.—London *Electrician*, May 31, 1912.

Electric Motors in the Textile Industry.—O. Reinhardt.—The conclusion of his illustrated paper on the use of electric motors in the textile industry, with special reference to individual motor drive.—*Elek. u. Masch.* (Vienna), May 26, 1912.

Electric Motors in Quarries.—P. N. Harrison.—An illustrated article on the electric operation of limestone quarries and crusher plants with data on energy consumption from actual operation in three quarries.—*Elec. Journal*, June, 1912.

French Water-Powers.—H. Bresson.—An article giving statistical data, with map, on water-powers in the Garonne River district in France.—*La Revue Elec.*, May 24, 1912.

Traction.

Electrification of Main-Line Railroads.—William J. Clark.—A Franklin Institute paper reviewing the present situation. It is emphasized that conditions of no two railways are identical. Electrification of each or all requires careful engineering consideration. The adoption of electric traction is principally dependent upon the financial results attainable therefrom. It is difficult to define exactly a main-line railroad. "Railroading" is "railroading," no matter by what motive power it is accomplished. The small unit is an important factor in perfecting railroad transportation methods. The comparatively high capitalization of street and electric railways is not entirely attributable to electric traction. The financial results obtained from electric operation of all kinds and types of railways justify its more general adoption by the steam railroads. Political and governmental agitation is principally responsible for America not having made greater advancement in this last-named direction.—*Journal Franklin Inst.*, June, 1912.

Direct-Current Mountain Railway.—An illustrated description of the direct-current railway from Biasca to Acquarossa in Switzerland. The maximum grade is 3.5 per cent, the mean grade is 1.7 per cent. The voltage of the trolley wire is 1200, the direct current being obtained from a substation from three-phase currents.—*Schw. is. Bauzeitung*, Vol. 58, 1911, pages 223 and 235; abstracted in *Elek. Zeit.*, May 30, 1912.

Pittsburgh.—G. Schimpff.—An illustrated article on the proposition of providing rapid transit for Pittsburgh on the basis of the proposition of B. J. Arnold.—*Elek. Zeit.*, May 30, 1912.

Installations, Systems and Appliances.

A New Energy Rate with Power-Limiting Device.—H. S. Hatfield.—Flat rates have become more and more popular in conjunction with a power-limiting device, but on special occasions consumers want to use a greater amount of power than they are permitted to do. To accommodate them the central station of Bremen permits them to apply to the station for short-circuiting the power-limiting device on a certain evening for a payment of 50 cents. The author has devised a prepayment apparatus which serves the same purpose; that is, when a certain piece of money is thrown into the apparatus the power-limiting device is automatically short-circuited for a number of hours. The feature of the apparatus is the omission of any complicated mechanism, no clockwork being used at all. When the coin is thrown in, the power-limiting device is short-circuited and the heat developed in a resistance wire evaporates a certain quantity of mercury. This quantity of mercury is chosen according to the number of hours for which the limiting device is to be short-circuited. When it is all evaporated a contact is broken and the power-limiting device is thereby automatically again connected to the circuit.—*Elek. Zeit.*, May 30, 1912.

Wires, Wiring and Conduits.

Rating of Cables.—J. Wagner.—An article in which the author compares the new rules of the (British) Institution of Electrical Engineers on the rating of cables with the rules of the German Association of Electrical Engineers and shows in what respects both are unsatisfactory, with suggestions of improvements.—London *Electrical Review*, June 7, 1912.

Copper-Clad Iron Wire.—Some notes on the manufacture of copper-clad iron wires, their physical constants and uses.—London *Electrical Review*, June 7, 1912.

Electrophysics and Magnetism.

Action of Ultra-Violet Light on Chlorine.—A. B. Ludlam.—The action of ultra-violet light upon many elements causes them to eject electrons, and the more electropositive the element the more easily is the electron ejected. The author has made extended experiments with chlorine, which is of particular interest as it is the most electronegative element. The author's experiments show that under the influence of ultra-violet light very little ionization is produced, even in ordinary air, by light of wave-lengths longer than 200 μμ. Pure dry air is not greatly ionized by wave-lengths longer than 180 μμ, but with shorter wave-lengths the ionization is considerable. The addition of a trace of water vapor to air enormously increases the amount of ionization. The addition of very small quantities of chlorine to ordinary air increases the amount of ionization, but with

more chlorine the reverse takes place. Pure chlorine is not ionized appreciably. Pure chlorine does not form condensation nuclei. Chlorine in considerable quantity destroys the ions and the nuclei otherwise formed in air. These results point to the fact that the atom of chlorine does not easily lose an electron, and this is what might be expected from its electronegative character.—*Phil. Mag.*, May, 1912.

Kinetic Theory of Matter and Atomic Theory of Electricity.—R. A. MILLIKAN.—A sketch of the gradual extension and evolution of our knowledge by which the kinetic theory of matter and atomic theory of electricity have now been so firmly established as to make it sure that they will never cease to be the cornerstones of physical science.—*Pop. Science Monthly*, May, 1912.

Units, Measurements and Instruments.

Location of Icebergs by Resistance Thermometry.—H. T. BARNES.—An abstract of a lecture held before the Royal Institution in London. The author indorsed Pettersson's theory that ice melting in the sea caused three currents to be set up, the cold sea water falling, the warmer sea water melting the ice and taking its place, and fresh water from the melted ice rising on the surface around it but not mixing with the salt water. Scientific advantage might be taken of this last phenomenon and the presence of fresher water be indicated by altered electrical conductivity. The "ice blink" and other signs of an iceberg's approach are more interesting than precise, and temperature changes in the sea have not hitherto been reliable owing to the crude methods of reading in vogue. But Pettersson's theory that some temperature effect would be produced by currents of fresh water from the melted ice suggested the idea of a recording microthermometer. An instrument was required which should be sensitive enough to record a variation of temperature of a thousandth of a degree as easily as an ordinary thermometer would record a variation of 2 deg. After many attempts and failures, the author succeeded in evolving a form of electrical resistance microthermometer which would register variations otherwise entirely overlooked and would indicate the presence of an iceberg at a distance of half a mile. The thermometer itself was fitted in a special iron cylinder attached to a guy rope for immersion in about 5 ft. of water and connected by wires to the recording instrument on deck. A portable form of galvanometer of somewhat special construction was employed, and its clock mechanism was so arranged that it would work anywhere and, indeed, worked better when there was vibration, the vibration destroying any false balance. The recording instrument contained a chart mounted on cylinders, on which a pen recorded the temperature. A series of microthermometric charts, some made in the North Atlantic only a month ago, showed how changes of temperature denoted the presence of icebergs. The characteristic changes and the rate at which they took place were more significant than the temperature itself. Generally there was a rise as a ship drew near a berg, followed by a sharp fall, and a rise after the berg had been passed. The first rise was probably due to absorption of the sun's heat by fresh water from the berg. According to one chart, this iceberg effect was observable even in water at a depth of 16 ft. below the surface.—London *Elec. Review*, June 7, 1912.

Hot-Wire Ammeter.—A. H. TAYLOR.—An illustrated description of a compensating, linear-scale, hot-wire ammeter. Therlo wire is used and the sagging of a wire spanned between two supports is utilized to rotate a mirror or deflect a needle as the case may be. The currents to be compared are carried through two widely separated and highly insulated circuits, so that the ammeter may be used on high-tension and high-frequency circuits. Fig. 1 is a view of the instrument with the cover removed. There are two independent systems of four therlo wires each, stretched between fiber posts set in an insulating base. Only two of these wires on either side take part in the indication of the instrument, the others being connected in at will as shunts to alter the sensitiveness of the ammeter. These shunts carry practically the same currents as the indicating wires, hence have the same temperature, and thus give a shunt ratio independent of the current strength. The two indicating wires on each side of the instrument are connected by light fiber bridges which pass inside of the shunt wires. The differential feature is provided for by two similar springs, which connect the two bridges with each other and with the end of the needle. The ammeter can be used as a direct-reading instrument, or as a comparator when both sides have been adjusted to the same sensitiveness.—*Phys. Review*, May, 1912.

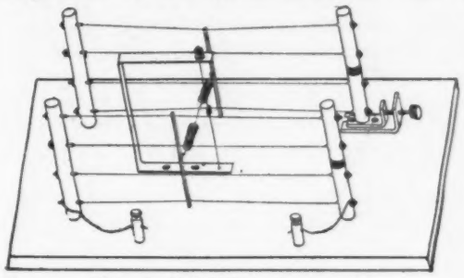


Fig. 1—Hot-Wire Ammeter.

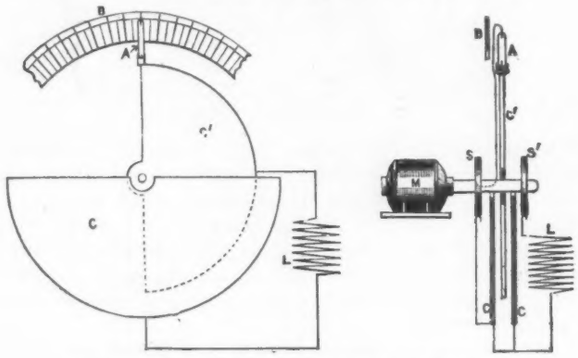
Accurate Potentiometer Method for Measuring Resistance.—WALTER P. WHITE.—An abstract of an American Physical Society paper. In this method the resistance is made part of a Wheatstone bridge which is not changed during the observations. The lack of balance, which may be relatively large, is not allowed to send a current through a galvanometer, but is measured by putting a potentiometer in the place usually occupied by the galvanometer alone. The method is best suited for measuring resistance changes rather than absolute values. It is obviously more accurate than the ordinary potentiometer methods, since the electrical quantity to be measured is much smaller and changes in the battery current produce far less effect. Its advantage over the simple Wheatstone bridge lies in the fact that no troublesome contact resistance changes occur during the measurements, and that the general advantages of the potentiometer can be secured along with some of the benefits of the Wheatstone bridge. It does not avoid the difficulty from temperature change in the coils which occurs in Wheatstone bridge work of high precision, but it facilitates the use of some methods which diminish this difficulty also. For instance, in temperature measurements it facilitates the use of resistance thermometers with two (or four) coils in the bulb, half of them of wire of low temperature-resistance coefficient. Some of the disadvantages which appear to have prevented the use of thermometers of this type might be obviated if the metal of low temperature-resistance coefficient should be the alloy of silver and platinum, which would endure much the same heat treatment as the pure platinum and very much more than would be admissible with manganin.—*Phys. Review*, May, 1912.

Prony Brake.—E. W. HENDERSON.—An illustrated description of a brake for testing motors of the general character of the Prony brake with several mechanical improvements facilitating its use.—*Elec. Journal*, June, 1912.

Telegraphy, Telephony and Signals.

Direct-Reading Wave-Meter.—S. M. POWELL.—An article giving further information on a new wave-meter devised by Erich Huth which has already been noticed in the *Digest*. It depends on the principle of resonance, but the resonant condition is attained automatically, and the frequency and wave-length of the oscillation examined are read directly on a permanent scale. In Figs. 2 and 3, representing the construction of the new instrument, *C* is a plate condenser, *L* an inductance coil and *A* a neon or helium tube, con-

nected so as to show, by its illumination, the occurrence of resonance in the tuning circuit. The movable plate of the condenser, carrying the neon tube on an extension arm, is rotated by clockwork or an electric motor, so that the capacity of C varies continuously and periodically over the whole range between its minimum and maximum values. During each rotation of C the resonant relationship between C and L for the particular case examined is swept through and, at the moment of its realization, the neon tube is lighted. This occurs at the same point in each revolution, and at a speed of the driving motor of 300 r.p.m. the resonant setting is passed five times per second, so that by persistence of vision the observer sees a steady band of light at the resonant position of C (and A). By placing a suitably calibrated scale B behind the path of motion of the tube A the frequency and wave-length of the oscillations exciting L can be read at once. The observed position is the mean of a number of rapidly successive automatic settings, and the whole conditions of working result in the readings being much more accurate than individual hand settings, besides being more easily obtained. Variations in the excitation of the tuning circuit merely alter the brightness of the indicating tube. Fluctuations in the wave-length measured cause a broadening or waving of the luminous band according to their frequency of occurrence. In using the meter the coupling coil is moved to and from the circuit under examination till the indicating band of light is from 0.5 mm to 1 mm broad. If sufficiently loose coupling cannot be obtained to yield a narrow band, readings are taken at the brightest part of the narrowest band obtainable. By simply disconnecting the condenser C, by withdrawing a knob in the base-plate of the instrument, the latter indicates the amplitude and purity of the oscillations examined.—London *Elec. Review*, June 7, 1912.



Figs. 2 and 3—Direct-Reading Wave-Meter.

Theory of Submarine Telegraph Cable.—H. W. Malcolm.—A continuation of his long illustrated theoretical serial. The author discusses the determination of arrival curves over a cable with a condenser at one of its ends and with condensers forming double block, also with a condenser placed somewhere along the line of the cable.—London *Electrician*, May 31, 1912.

Loaded Cables.—E. F. Petritsch.—The conclusion of his paper in which he compares Krarup telephone cables (uniformly loaded by spinning iron wire around the copper conductor) with Pupin cables (discontinuously loaded at regular intervals with induction coils). He concludes that with respect to technical efficiency the Krarup cable can still compete with the Pupin cable in various fields. But in this comparison the question of cost has not been taken into consideration and it is acknowledged that in general the Krarup cable is more expensive than the Pupin cable. Finally reference is made to further important progress made quite recently with a Pupin cable between England and Belgium, whereby the prospects of the Pupin system for submarine cables have been still further improved.—*Elek. u. Masch.* (Vienna), May 26, 1912.

Telegraphy and Telephony.—W. A. J. O'Meara.—A paper read before the Yorkshire section of the (British) Institution of Electrical Engineers on the present status of telegraphy and telephony, with special reference to the system of the British Post Office.—London *Electrician*, May 31, 1912.

Effect of Solar Eclipse on Wireless Telegraphy.—H. Schledermann.—A note on experiments made during a recent solar eclipse between two stations in Denmark, showing a remarkable strengthening of signals during the eclipse. This is due to the reduced action of the sunlight, and the phenomenon is the same as that which causes better receiving at night than during day.—London *Electrician*, May 31, 1912.

Miscellaneous.

South Africa.—An article giving statistical data on the electrical import trade into British South Africa in 1910 and 1911. Great Britain and Germany are the two countries which are the chief importers. The United States is mentioned as an importer of electric cable and wire, electric fittings, India rubber ($75,000 in 1911 against $15,000 in 1910), lamps, machine belts, electrical machinery, cranes, mining machinery ($800,000 in 1911), rails and other tramway and railway material.—London *Elec. Review*, June 7, 1912.

Bank for Electrical Undertakings.—C. Ergang.—An article giving a concise history of the Corporation for Electrical Undertakings in Berlin (Gesellschaft für Elektrische Unternehmungen), which is one of the big German corporations founded to finance the electrical industry. The beginnings of the corporation are outlined and it is shown how it gradually gave up manufacturing and concentrated its interests on operating companies. A table is given showing the financial development of the corporation from its beginning down to the present time.—*Elek. Zeit.*, May 30, 1912.

Electrical Factory.—An illustrated description of the various works in Berlin and neighborhood where the Siemens-Schuckert company and the Siemens-Halske company carry on the manufacture of electrical and engineering apparatus.—London *Electrician*, June 7, 1912.

Book Reviews

Electric Discharges, Waves and Impulses. By Charles Proteus Steinmetz, Ph. D. New York: McGraw-Hill Book Company. 149 pages, 64 illus.

In the review of this book which appeared in the issue of May 4 the price was incorrectly given as $2.50 instead of $2.

Télégraphie sans Fil. Par Prof. Dr. J. Zenneck. Traduit de l'allemand par P. Blanchin, G. Guérard et E. Picot. Paris: Gauthier-Villars. 385 pages, 332 illus.

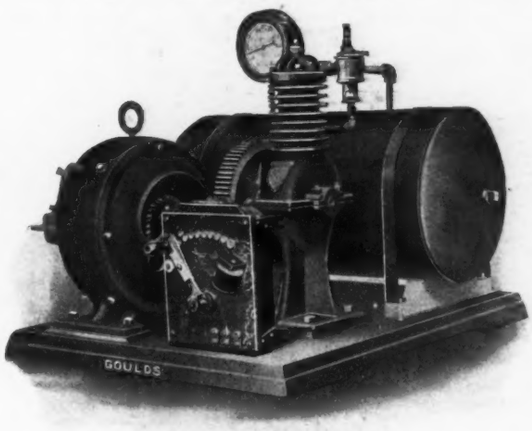
This work is based upon the larger treatise of the author on electromagnetic oscillation and wireless telegraphy, which has also been translated into French, and of which a knowledge is required in order to read easily these pages. While to some extent an abridgment of the earlier work, the author points out that in many respect it is a distinct book; for example, of the 332 illustrations, all but seventy-four are original.

The book devotes especial attention to the practical aspects of damping, couplings, resonance and propagation of waves along the surface of the earth. An appendix contains some useful tables, including one showing the increase of effective resistance with frequency. A bibliography adds to the value of the book. This volume and the larger work of the author constitute a contribution to the literature of wireless telegraphy to which only the work of Fleming approaches in importance.

New Apparatus and Appliances

MOTOR-DRIVEN AIR COMPRESSOR.

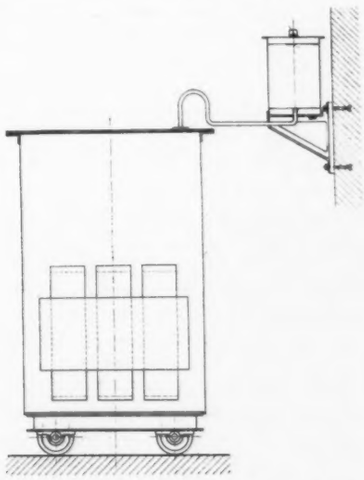
An air compressor comprising a self-contained set, the motor, starter and storage tank being mounted on an iron base, has recently been placed on the market by the Goulds Manufacturing Company, Seneca Falls, N. Y. The compressor is operated by a 1-hp motor and has been designed to handle 1.27 cu. ft. of free air per minute when operated at 150 r.p.m The tank is 28 in. long by 14 in. in diameter and will hold 3.25 cu. ft. of air at a pressure at 150 lb.



Motor-Driven Air Compressor.

EXPANSION CHAMBER FOR TRANSFORMER OIL.

It is essential for the reliability of oil-cooled transformers that the oil shall remain unaltered as long as possible. One cause of trouble has been the deterioration of the oil through chemical change and the formation of sludge. Experiments have demonstrated the fact that warm oil, if in immediate contact with air, absorbs oxygen from the atmosphere and undergoes a chemical change, while the change is almost negligible if the air is excluded.



Transformer Equipped with Oil-Expansion Chamber

The transformer shown in the illustration has been provided with a small tank, called the expansion chamber, which prevents the heated oil from coming in contact with the air. The expansion chamber is only partly filled with cold oil, as shown by the lower level in the tank. This oil remains cold and practically unaffected by contact with the atmosphere. As the transformer temperature rises a certain amount of warm oil will expand from the transformer tank past the bend of the siphon pipe into the expansion chamber, but this flow takes place slowly and the heated oil is comparatively cold when it reaches the expansion chamber. The expansion chamber offers the further advantage of preventing water from condensing on the cover of the transformer. In the ordinary design, without expansion chamber, the alternate expansion and contraction of the oil causes air to be sucked into and expelled from the transformer case. The air contains a certain amount of moisture which condenses on the cover when the transformer cools. The new arrangement is said to exclude completely the formation of water inside the casing.

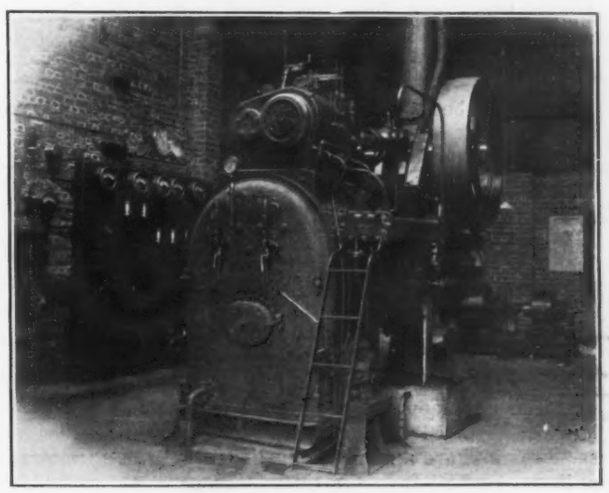
The outlet of the siphon pipe in the expansion chamber is arranged in such a way that any water which may collect in the expansion chamber cannot enter into the siphon pipe before the water level reaches a certain height. A drain-off screw is provided at the bottom, by means of which the lower portions of oil and any accumulation of water can be removed.

The Siemens-Schuckert company of Berlin is now providing all its medium-size and large-size transformers with such expansion chambers.

SEMI-PORTABLE STEAM-ENGINE GENERATING PLANT.

In the town of Dawlish, England, there is a small electric generating plant which possesses some interesting features. The plant is installed in a brick building and consists of an engine-room with ample space for future additional installations, a storage-battery room and an office for the engineer.

The generating equipment consists of a Garrett highly superheated, semi-portable steam engine which drives by means of a belt a Crompton 25-kw, 200-230-volt generator charging set. The engine is of the single-cylinder, non-condensing type. The steam distribution is effected by a balanced piston valve, and the cylinder and valve casing are jacketed with boiler steam. The superheater is of substantial construction and so placed that it can readily be kept



Semi-Portable Steam-Engine Generating Plant.

clean and in no way interferes with the use of the tube brush for the boiler flue. The engine has proved to be very economical, and a recent test made under ordinary running conditions showed a fuel consumption of 4.17 lb. of coal per kw-hr.

The battery consists of 116 cells with a total rating of 480 amp-hr. The usual switchboard and meter equipments are provided. Overhead mains and bare copper are used throughout, except for the connection between the generator charging set and the switchboard, where the connections have been made under the floor in pipes.

The plant was built for the town of Dawlish by Messrs. Crompton & Company, Ltd., of Chelmsford, England, and is operated by the Dawlish Electric Light & Power Company, the manager of which is Mr. C. C. Hodges.

VENTILATING FAN.

The equipment for the ventilating fan shown below, with its peculiarly shaped blades, is said to be very efficient, the arrangement employed having cost considerable experimental work. An 18-in. fan driven by a 1/16-hp motor is said to move 3400 cu. ft. of air per minute, and a 42-in. fan driven by a 1-hp motor moves 20,000 cu. ft. They are made by the Mechanical Appliance Company, Milwaukee, Wis., for both direct-current and alternating-current systems.

Ventilating Fan.

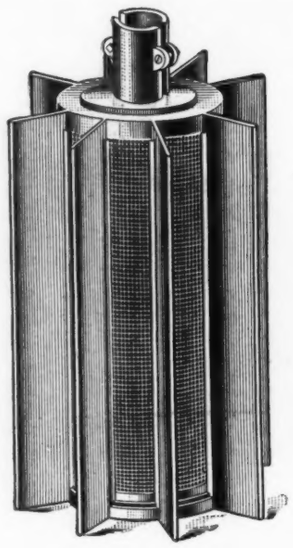
GROUNDING DEVICE.

A grounding device that is said to meet the requirements of electric lighting and telephone service is shown herewith. The construction embodies the salient features said to have proved effective in establishing a permanent earth connection.

This grounding device consists of a hollow cylindrical cast-iron shell approximately 5 in. in diameter and 12 in. long. Supported by this shell, and forming part of the same casting, are a number of longitudinal ribs that extend radially outward from the circumference of the cylindrical surface. The center of the box serves as a receptacle for holding a special hygroscopic compound of silicates, sodium, carbon and vegetable fiber. Connection to the ground box is made by means of a 1-in. galvanized-iron pipe that is screwed into the top of the casting and securely fastened to the body by means of a suitable clamping lug. The entire device is galvanized by the hot-dip process to eliminate corrosion due to electrolytic action or oxidizing of the exposed parts.

The device provides a surface of over 500 sq. in., so that the current density per unit area for any given discharge is reduced to a very small amount.

Another point that has received particular attention in this device is the method of supplying moisture to the earth immediately surrounding the ground connection. Tests have proved that in general practically all the resistance to a current from an electrical conductor to the surrounding earth lies within a few inches of the grounding device. Moreover, since the transfer of current is principally by means of electrolytic conduction, the effectiveness of any ground connection will be dependent upon the chemicals existing in the earth in intimate contact with the ground electrode and also upon the amount of moisture present. The hygroscopic compound tends to draw and retain a considerable amount of moisture.



Grounding Device.

In large installations of electrical apparatus where it is desirable to install a particularly heavy ground connection several ground boxes should be installed 5 ft. or more apart and connected together by a common grounding bus. This grounding device, called the "Maxum" ground box, has been placed on the market by the Fairmount Electric & Manufacturing Company, Philadelphia, Pa.

OIL ENGINE FOR LOW-GRADE FUELS.

In the accompanying illustration is shown a low-pressure internal-combustion engine of the hot-head type, which operates on the four-stroke cycle, using low-grade fuel oils. Simplicity, strength, ample bearing surfaces and absence of delicate parts are features of its mechanical design. The main frame is of the box form, heavy-duty type, cast solid with the casing forming the water-jacket and the two main bearings. A valve box containing the admission and the exhaust valves, located on the cam shaft side, permits the use of short, well-balanced valve levers, having the advantages of minimum noise and friction.

On the first outward stroke, the suction stroke, air is drawn into the cylinder through the valve box and a short pipe connecting with the inside of the main frame of the engine. At the same time, the rotary fuel-oil pump, which is driven by a belt from the cam shaft, sends a charge of fuel oil through a spray nozzle into the vaporizer, where it is vaporized by contact with the hot cap. On the return stroke the air and vaporized oil are compressed to a pressure of about 52 lb. per square inch, and the heat generated by the

compression stroke, added to that from the hot cap of the vaporizer, produces combustion of the mixture.

The second outward stroke is the impulse stroke, expansion taking place from a pressure rise of about 160 lb. per square inch. On the exhaust stroke the cylinder is scavenged.

The oils used are crude or fuel oils as heavy as 24 deg. Beaumé. The engines larger than 100 hp will operate on crude oils as heavy as 15 deg. Beaumé. These fuel oils are obtainable generally throughout the United States in tank-car lots at from 2 cents to 4 cents per gallon. Various grades of refinery by-product oils, all of which are cheaper than kerosene, are also used in these engines. The fuel

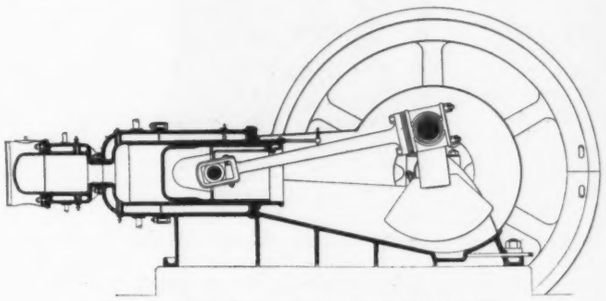


Fig. 1—Cross-Section of Crude-Oil Engine.

consumption guaranteed is 1 lb. of oil per brake-horse-power per hour, but recent tests of these engines by Prof. W. T. Magruder, of the mechanical engineering faculty of Ohio State University, showed even a lower consumption than this.

In these tests, which were made on a 50-hp engine, the fuel oils used were Texas "Solar oil" from the Gulf Refining Company, "34 deg. Beaumé distillate," and "Aladdin Security" kerosene from the Standard Oil Company. The fuel consumption varied with load as follows, the tests being made at 1235 ft. above sea-level:

Oil.	Brake-Hp.	Pounds per Hour.	Pounds per Hp-hour.
Solar	0.0	11.3	....
Solar	19.8	23.3	1.18
Solar	35.0	33.9	0.97
Solar	49.3	41.7	0.85
Solar	61.8	51.0	0.83
Kerosene	42.8	42.8	0.88
Distillate	49.3	42.5	0.86

The amount of lubricating oil used for 1000 brake-hp-hours at full load was 1.3 gal., and a water consumption of

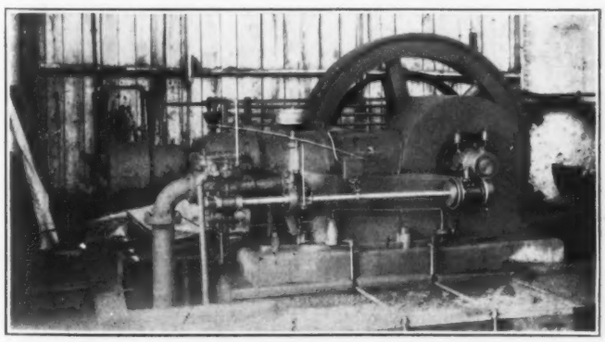


Fig. 2—Crude-Oil Engine Installation.

from 7 gal. to 8 gal. per brake-hp-hour gave satisfactory results. The time required to start the engine when cold was found to be four minutes and twenty-five seconds, which is the average of four runs and represents the interval between lighting the torch and picking up of load by the engine. The engine is built in ratings from 50 hp to 300 hp by the Covington Machine Company, Covington, Va.

200-MILE ELECTRIC ROADSTER.

Mr. Herbert George, a business man of Denver, Col., operates an electric roadster which is making runs of 203 miles per charge, after three years' use, during which time the car has totaled 20,000 miles. From Denver to Colorado Springs is a distance of 75 miles, and despite the severe grades of the Colorado roads Mr. George has

200-Mile Electric Roadster.

found no difficulty in making the round trip to the resort in a day, with enough surplus charge left in his batteries for an ordinary day's business use of the car in the city streets after his return. In all the three years there has been no outlay for repairs, while the cost of charging, washing, stabling and garaging the car has not exceeded $8 a month, according to the Denver Gas & Electric Company, which furnishes energy for charging. Ordinarily the car is charged only once a week, receiving energy sufficient for the entire seven days' run. The car is a Detroit Electric equipped with Edison nickel iron cells and is declared to be giving better mileage performance in its third year than while new.

ALTERNATING-CURRENT GENERATORS FOR KEOKUK, IA.

Simultaneously with the construction of the power house for the hydroelectric development on the Mississippi River at Keokuk, Ia., the initial generating equipment, comprising fifteen large alternating-current generators, is now being built in the shops of the manufacturers at Schenectady, N. Y. The generating station, when completed, will measure 1718 ft. in length, with a width of 132 ft. 10 in. and a total height of 177 ft. 6 in. The superstructure will be 107 ft. 6 in. from the generator floor to the pinnacle. An ultimate capacity of thirty generating units is provided for in the station plans. It will be recalled from previous descriptions which have been published in these columns concerning the Keokuk project that the turbines will be of the Francis single-runner vertical type, with a normal capacity of 10,000 hp each.

Each turbine and generator will form an independent unit, and the revolving field of the generator will be supported on the top of the 25-in. vertical wheel shaft, directly over the turbine. An assembly view of one of these generators is shown in the accompanying illustration. The overall diameter of these machines is 36 ft. and their height

is 12 ft., while the total weight will exceed 300 tons. Three-phase alternating current will be generated at a pressure of 11,000 volts, at the rated speed of 57.7 r.p.m. Each of these generating units will have a rated capacity of 7500 kw. Eight water-cooled 110,000-volt transformers will be installed for raising the pressure for transmission to Burlington, Ia., and St. Louis, Mo., the latter city being 137 miles distance.

7500-kw Generator for Keokuk Hydroelectric Plant.

The direct-current excitation for the main generating units will be supplied by 100-kw motor-generator sets, which in turn will receive energy from a 200-kw alternating-current waterwheel-driven generator. The ultimate output of the main generating system will be 225,000 kw or 300,600 hp. The public-utility corporations in St. Louis have already contracted for 60,000 hp, out of a total of 200,000 hp which has been offered for sale. An idea of the magnitude of this hydroelectric development may be obtained from the statement recently made that it will develop about three times the power now used for manufacturing in the State of Iowa, or more than is now used in the State of Missouri, or, again, about one-third of that now used in the entire State of Illinois. The Mississippi River Power Company, which is the proprietor of this great development, promises that operation will commence not later than July 13, 1913. The generating equipment is being furnished by the General Electric Company.

TIME-PHASE SHIFTER FOR WATT-HOUR-METER TESTING.

It is well known that a watt-hour meter that registers accurately a load at one power-factor may give incorrect registrations when the power-factor departs from this value. It is essential, therefore, to test a watt-hour meter throughout the full range of power-factor encountered in service. In order to avoid the inconvenience of changing the actual power-factor of the test load there has been developed the device illustrated herewith, which permits one to shift the relative time-phase positions of the currents in the series and shunt coils of the watt-hour meter without changing the character of the load. The apparatus includes two auto-transformers. One is connected in one phase of a two-phase or three-phase circuit and is provided with a multiplicity of taps for obtaining different potentials in that phase. The auto-transformer also has a multiplicity of taps, and by connecting this between the third wire of the circuit and the taps of the first auto-transformer, emfs of various time-phases are set up in the second auto-transformer. By using the proper taps of the second auto-transformer the value of the emf is kept constant. A dial switch is connected to the various taps of the two auto-transformers in such a way that by turning the switch handle a constant emf of predetermined relative time-phase is obtained for each position of the dial switch.

The diagram of Fig. 2 shows the interconnection employed to obtain the desired results. *A, B* and *C* represent the three conductors of a three-phase circuit from any three-phase source. The two auto-transformers of the phase-shifter are shown at *OT* and *NM; NM* is connected to the line conductors *AC* at the points *P'* and *M*. The other auto-transformer *OT* is permanently connected at the point *O* with the line wire *B*. With the auto-transformer *OT* connected as shown in the diagram, with the tap *E* connected at the corresponding tap *E* on the auto-transformer *NM*, the emf set up in the auto-transformer *OT* will have a relative time-phase position to the emf between the wires *BC* represented by the angle *EOM*. If the load current to the watt-hour meter is taken from the phase *BC* through the series coil *S* and the emf for the shunt winding *V* from the auto-transformer *OT* at the points *O* and *P*, it is evident that the emf in the shunt winding will differ in time-phase from the current in the series winding by the angle *EOM*. It is readily seen that if the auto-transformer *OT* is connected between *O* and some other point of the auto-transformer *NM*, as at *P'*, the phase of the emf on the shunt winding will have a different time relation to the current in the coil *S* but the value of the emf will remain the same. By providing proper taps on the two auto-transformers, any desired time-phase relation may be obtained, and it is evident that if the auto-transformer *OT* occupied the position *ON*, there would be a difference in time-phase of 90 per cent between the emf and current which would be equivalent to a power-factor of zero. The above-described time-phase shifter has been placed on the market by the States Company, 202 West Water Street, Syracuse, N. Y.

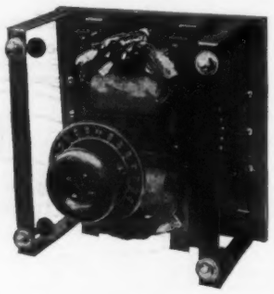


Fig. 1—Time-Phase Shifter for Watt-Hour-Meter Testing.

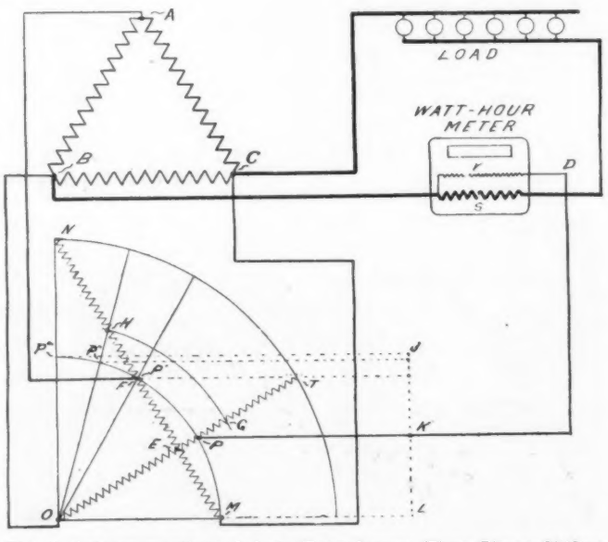


Fig. 2—Interconnection of Auto-Transformer Time-Phase Shifter.

Industrial and Financial News

COMMENT on the trade situation continues to be optimistic in tone, and a general impression obtains in financial circles that conditions are ripe for business expansion despite the disquieting influences of the political campaign. Crop conditions are still promising in nearly every section of the country, and in some of the agricultural districts that were backward favorable weather has prevailed during the week. Production of steel is going forward at record rates, demand for nearly all the metals is good, and higher prices for iron and steel are being asked by nearly all dealers. New business is being placed with the mills in large volume, orders for railroad equipment forming a fair proportion. Some scarcity of labor is reported here and there. Railroad officials, returning from inspection tours, say that the outlook is very favorable in spite of the facts that tonnages are not so large as might be desired and that some feeling of conservatism still exists. There have been no changes of moment in the money market during the week. Rates on June 26 were: Call, 2¾@3 per cent; ninety days, 3¼@3½ per cent.

Illuminating & Power Securities Corporation Formed.—A company known as the Illuminating & Power Securities Corporation was incorporated recently under Virginia laws to deal in securities and in properties of public-service corporations. Its president is C. P. Hamilton, and S. W. Childs and R. C. Morse are its vice-presidents. These, with M. P. Clough, W. S. Clough, F. W. Stehr and E. B. Tracy, are its directors. The new company has $3,000,000 preferred stock, cumulative at 7 per cent after August 1, 1912, and $5,000,000 common stock. Of the former $1,250,000 is to be issued. All of the $5,000,000 common stock is outstanding, and among other considerations the following securities will be turned over to the new corporation in return for this amount of common stock: American Gas & Electric Company, 500 shares common; American Power & Light Company, 500 shares common; American Utilities Company, 1000 shares common; Appalachian Power Company, 2000 shares comman and 320 shares preferred; Consolidated Power & Light Company of South Dakota, 1343 shares common and 267 shares preferred; Federal Utilities, Inc., 300 shares common; Fort Worth Power & Light Company, 2000 shares common; General Electric Company, 250 shares common; General Utilities Corporation, 200 shares preferred; Guanajuato Power & Electric Company, 2000 shares common; Northern Idaho & Montana Power Company, 810 shares common; Pacific Gas & Electric Company, 1000 shares common; Pennsylvania Water & Power Company, 410 shares common; Republic Railway & Light Company, 1000 shares common; San Juan Water & Power Company, 803 shares common; Southern California Edison Company, 1000 shares common; Standard Gas & Electric Company, 2000 shares preferred and 1000 shares common; Tennessee Railway, Light & Power Company, 500 shares common; United Railways Company of St. Louis, 500 shares preferred; Washington, Baltimore & Annapolis Electric Railroad Company, 600 shares preferred and 1801 shares common; Western Power Company, 700 shares preferred and 2500 shares common. At the present time the securities turned over to the Illuminating & Power Securities Corporation are paying dividends at the rate of about $25,000 per year. The proceeds from the sale of the corporation's preferred stock will be invested in public utility issues on such basis that the yield thereon will be sufficient to meet the preferred-stock dividend, which, with the $25,000 to be received from the securities turned over to the company for its common stock, will enable the company to start with earnings from income, as above, equal to practically one and three-tenths times its preferred-stock dividend.

Toledo Railways & Light Reorganization.—Plans for reorganization of the Toledo Railways & Light Company have been prepared by the sub-committees representing the bondholders and stockholders of the company, and these plans are to be presented shortly at a meeting in Toledo. Both plans provide for reducing the company's present capitalization by about $13,730,000 and provide further for the organization of two new companies. The electric lighting, power, gas and heating plants, in accordance with these plans, will be owned and operated by the parent company, which will also hold all the stock of the street railway company, making this a subsidiary corporation. The plans of the reorganization committee provide for the raising of about $8,500,000 new capital in cash. If the plans are adopted the new company will be capitalized at $21,000,000, as follows: First-mortgage 5 per cent bonds, $5,000,000; 6 per cent first preferred stock, $4,000,000; 4 per cent second preferred stock, $6,000,000, and common stock, $6,000,000. The plan provides for the sale of the first-mortgage bonds and the first preferred stock in order to furnish funds to pay off the outstanding $6,000,000 first-mortgage bonds, $1,275,000 bank loans, some $500,000 current liabilities, and various other amounts advanced to meet interest on underlying securities. Opportunity will be given to holders of the $4,866,000 consolidated 4 per cent bonds of the company to exchange these for the 4 per cent preferred stock, and stockholders will receive an offer to subscribe to the new common stock on a basis that would mean an assessment of approximately $7 on each share of the old stock. The plan provides that present stockholders who do not subscribe to the new stock shall receive an amount of common stock of the new company equal to about one-seventh the amount of stock allotted to the holders that do subscribe under the plan.

Northern States Power Company Notes.—Five-year 6 per cent collateral-lien notes of the Northern States Power Company, the principal and interest on which are guaranteed by the Consumers' Power Company, are being offered by H. F. Bachman & Company, of Philadelphia and New York, at par and interest. These notes are dated June 1, 1912, and are due June 1, 1917, but are subject to call, as a whole, on any interest date on sixty days' notice on or before June 1, 1914, at 102 and after then at 101. The total amount authorized and issued is $5,000,000. They are secured by deposit with the trustee of the capital stock of the Minneapolis General Electric Company and $5,000,000 general-mortgage 5 per cent bonds of the Consumers' Power Company dated June 1, 1912, and due June 1, 1937. The cost to the Northern States Power Company of the stock of the Minneapolis General Electric Company was $7,950,000 in cash, and the notes now offered were issued in part payment, the balance being provided through sale of preferred and common stock of the Northern States Power Company. The interests controlling the latter estimate that the replacement value of its subsidiary properties is $27,419,000.

Great Western Power Wins Suit.—According to advices from San Francisco, the California Railroad Commission has rendered a decision granting the Great Western Power Company the right to extend its lines into territory across San Francisco Bay, where service is now furnished exclusively by the Pacific Gas & Electric Company. The policy of the commission, it is understood, is to encourage competition of public-utility companies where such competition will not reduce earnings below a reasonable amount. Gross earnings of the Great Western company and its subsidiaries for April were $184,228, net earnings were $113,061, and the surplus after charges was $20,720. For the four months ended April 30 the gross earnings were $720,904, the net earnings were $449,954, and the surplus after charges was $82,596.

Orders for Electric Furnaces.—The Pittsburgh Electric Furnace Company, builder of electric furnaces for the smelting of steel, iron, copper, zinc and other metals, has received recently a number of orders for the installation of several furnaces with a melting capacity of 1000 lb. per hour. These orders include sales to the following companies: United States Reduction Company, aluminum, Pittsburgh; Great Western Refining & Sintering, brass turning, St. Louis; P. Healy, tilting furnace for brass, Evansville, Ind.; Electric Railway & Improvement Company, copper, Chicago.

Annual Report of Marconi's Wireless Telegraph Company, Ltd.—In their report to the stockholders for the fiscal year ended Dec. 31, 1911, the directors of Marconi's Wireless Telegraph Company, Ltd., make particular reference to the extensive installation of wireless telegraph facilities throughout the world made by their company last year. The agreements between the company and the British Postmaster-General last March, providing for construction of long-distance wireless stations to be operated by the government, and for payment of 10 per cent of the gross receipts from these to the Marconi company, are also held by the directors to be among the achievements of the year. All of the subsidiary companies are shown to be in a flourishing condition. The consolidation of the United Wireless Company with the American Marconi company, the final obstacle to which was removed last week by settlement of the patent suit between the former and the National Electric Signaling Company, is mentioned as another favorable feature of the year's work. Attention is called to the arrangements which have been made with Messrs. Bellini & Tosi, inventors of the wireless compass, by means of which sole universal rights to this invention were obtained by the Marconi company. The net returns of Marconi's Wireless Company, Ltd., last year, as briefly mentioned in these columns June 15, were twice those in the preceding year, the net revenues being $708,585 and $307,565 respectively. Owing to the continual increase in business, the manufacturing facilities of the factory at Chelmsford, Eng., were heavily taxed during the year, and on this account it was found necessary to erect another factory, which is rapidly nearing completion.

Adirondack (N. Y.) Electric Power Company's Business Expands.—A considerable increase in the volume of business done by the Adirondack Electric Power Corporation has taken place in the past five months. As was mentioned in these columns Jan. 6 and April 27, this company was organized under the laws of New York on Dec. 27, 1911, to take over the properties and franchises of the Hudson River Water Power Company and its seven affiliated companies. It has been under the supervision of Stone & Webster since organization, and various changes which the latter have made in the plants and in operating methods have contributed to increased returns. It is now believed that this company will be able to begin payment of preferred dividend, possibly at 4 per cent, considerably before the close of 1916, when the preferred dividend becomes cumulative at 6 per cent.

$40,000,000 Brooklyn Rapid Transit Notes Oversubscribed.—The Central Trust Company, Kuhn, Loeb & Company and Kidder, Peabody & Company, who compose the syndicate which is financing the Brooklyn Rapid Transit Company's share of the cost of New York's new subway system, announced this week that the $40,000,000 six-year 5 per cent notes of the Brooklyn company, which were offered to subscribers at 96.65, were largely oversubscribed. These notes are secured by an equal amount of first-mortgage sinking-fund 5 per cent bonds of the new subway company to be formed by the Brooklyn Rapid Transit Company. They are also secured by pledge of $10,000,000 Brooklyn Rapid Transit convertible 4 per cent refunding bonds. The notes are convertible into first-mortgage bonds of the new company at the option of the holder until Jan. 1, 1916.

United States Independent Telephone Company Assessment.—The voting trustees of the United States Independent Telephone Company, of Rochester, N. Y., which was adjudged insolvent in April, 1908, have been directed to pay an assessment of $5.40 on each of the 385,975 shares of common stock which stand in the joint names of the voting trustees. When the company was declared insolvent the proceeds of the property brought only enough at foreclosure sale to pay $13 on each $1,000 bond. The order just made directing the assessment provides for the deficiency and further provides that if the assessment is not paid F. L. Johnson, the receiver, shall have authority to sue for its collection.

Southern California Utilities Merger Planned.—Options on the Ramona Power & Irrigation Company, the Lake Hemet Water Company, the Fairview Land & Water Company and the Hemet Town Water Company have been obtained by the Southern California Utilities, a corporation recently organized to consolidate a number of public utility companies in Southern California. If the California Railroad Commission grants the application of the Southern California Utilities to issue $10,000,000 bonds, a merger of the above-named companies will be effected. Nearly $5,000,000 of the proceeds from the sale of these bonds will be used in improving the properties of the Ramona Power & Water Company.

American Light & Traction Earnings Improve.—May earnings of the American Light & Traction Company were the most favorable thus far in the current fiscal year. Gross earnings were $320,719, an increase of $11,111 over May, 1911, and net earnings were $310,027, an increase of $10,326. Net earnings for the twelve months ended May 31 were $98,043 in excess of those in the corresponding period last year. The company's showing indicates that the new business which is being secured is more than sufficient to offset the loss incurred through reduction in rates in the fall of 1911.

New Western Union Rates.—Announcement has been made by the Western Union Telegraph Company that it will establish on July 1 a new 30-cent minimum rate zone for telegraph messages applying throughout the country. The company heretofore has had practically no intermediate minimum rate between 25 cents and 40 cents, and on this account many messages only slightly over the 25-cent zone distance have been charged for on the 40-cent basis. A great number of ten-word messages, heretofore charged at 40 cents, will be taken at 30 cents.

Western Electric's May Showing.—As had been expected, the 17 per cent increase in gross earnings of the Western Electric Company in the month of April, of which mention was made in the *Electrical World* May 18, was not sustained in the month of May. Gross sales last month were about 3 per cent behind those in May, 1911, so that the total business in the past five months of the present fiscal year is 1 per cent ahead of that in the corresponding period of 1911. No new financing or construction is under consideration by the company.

Change in Name of Public Utility Company.—The American Public Utilities Company, incorporation of which was noted in the previous issue of the *Electrical World*, is the corporation which was recently organized as the American Utilities Company. As there was already a company by this name, organized under Maine laws, reference to which was made in these columns March 30, the organizers of the new company decided to make the slight change in name in order to avoid confusion.

Carolina-Tennessee Power Company Chartered.—Extensive hydroelectric developments on the Hiwassee River near Murphy, N. C., are being planned by the Carolina-Tennessee Power Company, which has been chartered under the laws of North Carolina. The project is still in the engineering stage. The company has an authorized capitalization of $5,000,000 stock and $5,000,000 5 per cent fifty-year bonds. The headquarters of the company are at 115 Broadway, New York.

To Build Hydroelectric Plant Near Muskogee, Okla.—Plans are being made by the Muskogee (Okla.) Water Power Company for erection of a 15,000-hp hydroelectric plant on the Grand River, near Muskogee. S. P. Mann is president of the company, which was organized several months ago. The engineering work will be in charge of W. H. Rosecrans, consulting engineer, of Chicago. Work will be started by the middle of this summer.

May Dam Fraser River, in British Columbia.—According to press advices from Vancouver, B. C., application has been made to the Dominion government by the International Railway Company for permission to dam the Fraser River near Yale, B. C. It is planned to develop energy for operating electric railways on the lower mainland. United States capital, it is said, is promoting the enterprise.

McCrum-Howell Reorganization.—The plans for reorganization of the McCrum-Howell Company will not provide for stock assessment. Stockholders will be offered the privilege of subscribing to the underwriting syndicate, which will provide funds in lieu of assessment.

Consolidation of Sao Paulo (Brazil) Utilities Planned.—The Brazilian Traction, Light & Power Company, Ltd., is to be organized to take over the properties of the Rio de Janeiro Tramway, Light & Power Company, Ltd., the Sao Paulo Tramway, Light & Power Company, Ltd., and the Sao Paulo Electric Company, Ltd., of Sao Paulo, Brazil. The new company will have an authorized capital of $120,000,000, made up of $70,000,000 common stock and $50,000,000 6 per cent participating non-cumulative preferred stock. The company will be organized under the laws of the Dominion of Canada, with the following board of directors and officers, and with its head office at Toronto, Can.: Sir William MacKenzie, Toronto, chairman; F. S. Pearson, London, president; E. R. Wood, D. B. Hanna, Z. A. Lash, Miller Lash, Sir H. M. Pellatt, all of Toronto; Sir William Van Horne, Montreal; Alexander Mackenzie, Rio de Janeiro; H. Malcolm Hubbard, London; Alfredo Maia, Rio de Janeiro; R. M. Horne-Payne, London; Percival Farquhar, Paris; J. M. Smith, treasurer. There will also be a director from each of the cities of Paris and Brussels, representng the interests in France and Belgium. After careful consideration, the boards of the three companies decided that it would be advisable in the interest of the shareholders to bring the companies together through an exchange of shares of the Brazilian Traction, Light & Power Company, Ltd., to be organized for the purpose, as by so doing the rights and privileges of the three companies could be better safeguarded, the properties more economically developed and operated and additional capital more readily provided for future development of the enterprise. Many of the larger shareholders of the three companies, representing a large percentage of the total capital, have already agreed to the plan.

United Gas & Electric Corporation (Conn.) Notes Offered.—Bertron, Griscom & Jenks and Hallgarten & Company, of New York, are offering jointly with Montgomery, Clothier & Tyler, of Philadelphia, $5,000,000 three-year convertible 5 per cent notes of the United Gas & Electric Corporation of Connecticut, at 97½ and interest, yielding 6 per cent. This corporation, as noted in these columns May 25 and June 1, controls through stock ownership public utility companies operating in fifteen towns and cities, including Buffalo, Elmira and Lockport, N. Y.; New Orleans, Hartford, Conn.; Lancaster, Wilkes-Barre, Altoona and Harrisburg, Pa.; Houston, Tex.; Leavenworth, Kan., and Colorado Springs, Col. The notes are secured by deposit of all the common stock of the United Gas & Electric Company of New Jersey, the Harrisburg Public Service Company, the Lancaster County Railway & Light Company, the Houston Gas & Fuel Company, the Consumers' Electric Light & Power Company, New Orleans, and the International Traction Company, of Buffalo, N. Y. Earnings of the subsidiary companies in the past twelve months applicable to interest requirements on these notes were more than 400 per cent of the interest requirements. The officers of the company are: President, George Bullock; vice-presidents, R. E. Griscom and S. J. Dill; secretary and treasurer, Henry Morgan; assistant secretary and assistant treasurer, M. D. Evans. These, with the following, are the directors of the company: M. W. Dodge and H. Bronner, of New York; Samuel Insull, of Chicago; S. C. Dunham, of Hartford, Conn.; W. W. Griest, of Lancaster, Pa.; John S. Jenks, Jr., of Chestnut Hill, Pa.; G. E. Shaw, F. M. Potts, R. L. Montgomery and John Gribbel, of Philadelphia.

Securities of Doherty Company Sold Abroad.—On June 24 $4,500,000 5 per cent bonds of the Consolidated Cities Light, Power & Traction Company were offered for public subscription in London at 87½ and were oversubscribed within five hours. As noted in these columns last week, this company was recently incorporated by H. L. Doherty & Company with a capital stock of $10,000,000 and $25,000,000 in bonds as a holding company for the following companies: Dominion Natural Gas Company, Ltd., of Pittsburgh, Pa.; Alliance (Ohio) Gas & Power Company; Trumbull Public Service Company, of Warren, Ohio; Massillon (Ohio) Electric & Gas Company; Bristol (Tenn.) Gas & Electric Company; Cumberland (Md.) & Westernport Electric Railway Company; Knoxville (Tenn.) Gas Company; Meridian (Miss.) Light & Railway; Amarillo (Tex.) Gas Company; Sedalia (Mo.) Light & Traction Company, and the Citizens' Gas & Electric Company, of Mount Vernon, Ill. All of the subsidiary companies will be under the management of the Doherty Operating Company.

Suit Over Sale of Louisville Lighting Companies.—A temporary injunction in favor of the city of Louisville in the suit brought by it to prevent the consolidation of the Kentucky Electric Company, of Louisville, with the Louisville Lighting Company, or the taking over of the Kentucky Electric Company by H. M. Byllesby & Company, has been granted by Judge Quarles in the chancery division of the Jefferson Circuit Court. The case will be carried as soon as possible to the Court of Appeals in order that the latter may pass on the right of the defendants to acquire the property.

City Water Power (Tex.) Bonds.—Laurence Barnum & Company, of New York, are offering the unsold balance of $750,000 first-mortgage 5 per cent bonds of the City Water Power Company, of Austin, Tex., at 97½ and interest to yield 5.20 per cent. These bonds are secured by first lien on property with a replacement value of about $1,250,000, interest and principal being secured by contract with the city of Austin, Tex. Bonds are drawn by lot annually for the sinking fund at 102½ and accrued interest.

To Merge Public Utilities in Washington, D. C.—Stockholders of the Washington (D. C.) Railway & Electric Company will hold a special meeting on Aug. 15 to vote upon a proposition to consolidate the Anacostia & Potomac River Railroad Company, the Brightwood Realty Company and the Washington, Woodside & Forest Glen Railway & Power Company with their company. A majority of the stock of these companies is now owned by the Washington Railway & Electric Company.

Head of National Chamber of Commerce Urges Commercial Unity.—Harry A. Wheeler, president of the Chamber of Commerce of the United States, which was formed in the early part of the year, as noted in these columns April 27, advocated greater unity in commercial lines, in an address he made in Chicago on June 25 before the National Press Association.

Underwrite Electric Bond & Share Stock.—An issue of $1,500,000 6 per cent preferred stock of the Electric Bond & Share Company has been underwritten by W. P. Bonbright & Company, who are offering the stock at par and accrued dividends.

PRICES IN THE NEW YORK METAL MARKET.

Copper:	June 18 Bid.	June 18 Asked.	June 25 Bid.	June 25 Asked.
Standard:				
Spot	17.00	17.37½	16.75	17.50
June	17.00	17.37½	16.75	17.50
July	17.12½	17.37½	16.87½	17.37½
August	17.12½	17.37½	17.00	17.32½
September	17.12½	17.37½	17.00	17.32½
London quotation:	£ s d		£ s d	
Standard copper, spot	79 11 3		77 2 6	
Standard copper, futures	80 3 9		78 0 0	
Prime Lake	17.55		17.20 to 17.40	
Electrolytic	17.45		17.10 to 17.30	
Casting	17.25		17.00	
Copper wire, base	18.50		18.75	
Lead	4.50		4.50	
Sheet zinc, f.o.b., smelter	8.65		8.65	
Spelter, spot	7.10		7.10	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	21 to 22		21 to 22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	16.50		16.50	
Brass, heavy	10.25		10.25	
Brass, light	8.50		8.50	
Lead, heavy	4.25		4.25	
Zinc, scrap	5.75		5.75	

COPPER EXPORTS IN JUNE

Total tons, including June 18.....14,377 June 25.....18,961

STOCK MARKET PRICES

	June 19.	June 26.
Allis-Chalmers	¾*	¾*
Allis-Chalmers, pf.	2⅛*	2½*
Amalgamated Copper	86⅞	86⅞
Amer. Tel. & Tel.	145⅞*	146⅜
Boston Edison	285*	290*
Commonwealth Edison	138¼	139
Electric Storage Battery	56½	55
General Electric	170½	174½
Mackay Companies	88⅞	87⅝
Mackay Companies, pf.	68⅝*	69⅜
Philadelphia Electric	22⅛	22¼
Western Union	82⅞	83
Westinghouse	73	74½
Westinghouse, pf.	117*	117*

*Last price quoted.

Personal

Mr. C. M. Rogers, who was recently appointed combustion engineer of the Empire District Electric Company, Joplin, Mo., is just recovering from a six weeks' attack of typhoid fever.

Mr. R. T. Guppy, who was in charge of the San Francisco suburban electrification work for the Southern Pacific, has been placed in charge of similar work for this company at Portland, Ore.

Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, has had the honorary degree of doctor of laws conferred upon him by Middlebury College, Middlebury, Vt.

Mr. E. H. Shufro has resigned as purchasing agent for the Union Electric Light & Power Company, St. Louis, Mo., to become associated with Mr. W. V. N. Powelson, consulting engineer, New York.

Mr. A. K. Baylor, Schenectady, N. Y., delivered an address on "Comparison of the Development of Electric Public Service in England and in the United States" before the Colorado Electric Club, Denver, on June 6.

Mr. Arthur R. Kelly, Olympia, Wash., who has been in the employ of the Washington Public Service Commission for several years, has been appointed assistant expert electrical engineer to the Washington State Railroad Commission.

Sir Oliver Lodge, principal of the Birmingham University, is the author of a paper on "The Irrationality of War" in the July number of *International Conciliation,* which is published by the American Association for International Conciliation.

Mr. Roy A. Field has resigned as superintendent of the Rome (N. Y.) Gas, Electric Light & Power Company, to become manager for J. G. White & Company of lighting plants at Frankfort, Owensboro, Bowling Green, Hopkinsville and Clarkville, Ky.

Mr. J. C. McQuiston, of the Westinghouse Electric & Manufacturing Company, presented a series of motion pictures illustrating the present-day conveniences of electricity in the household before the Portland (Ore.) Railway, Light & Power Company on June 18.

Mr. Albert O. Hunt has resigned as superintendent of the London (Ont.) Electric Company to become assistant general manager and motor-service solicitor for the Hydro-electric Power Commission of Ontario, Canada. Mr. Hunt will assume his new duties during August.

Mr. William R. Power, formerly superintendent at Altoona, Pa., for the American Railways Company, has been placed in charge of the commercial department of the Consolidated Light, Heat & Power Company, which is controlled by the American Railways Company.

Mr. Howard Lancaster has resigned his position as city electrician of Paris, Ky., to become superintendent of the telephone service of the Lexington & Eastern Railroad, Lexington, Ky. The vacancy is being filled temporarily by the appointment of Mr. Vernon McGouldrick, of the Paris Gas & Electric Company.

Prof. Olin J. Ferguson is severing his connection with Union College, Schenectady, N. Y., where he has been associated with Dr. C. P. Steinmetz in the electrical engineering department for the past seven years. He has accepted appointment as head professor of electrical engineering in the University of Nebraska and will remove to Lincoln on or about Sept. 1, 1912.

Mr. Oscar M. Frykman has been appointed city electrician of Minneapolis, Minn., succeeding **Mr. F. G. Dustin,** who resigned his position to enter the commercial field as manager of the Northern Electrical Company of Minneapolis. Mr. Frykman is an electrical man of experience and has served as first assistant in the city department during the last three years.

Mr. William H. Marsh, who for the past ten years has been connected with the Standard Underground Cable Company, of Pittsburgh, Pa., as superintendent of construction, has been appointed secretary and assistant treasurer and sales manager of the Standard Underground Cable Company of Canada, Ltd., with headquarters at Hamilton, Ont. Associated with Mr. Marsh as assistant sales manager will be **Mr. H. G. Burd,** who for some time has been sales engineer in the New York office of the company.

Mr. Robert Morrison, Jr., for the last six years secretary and treasurer of the Michigan United Railways, Jackson Mich., and later secretary of the Michigan United Traction Company, has resigned his position with the latter company, to take effect July 1. This change is made by Mr. Morrison in order that he may give closer personal attention to his interests in the Georgia Power Company, of Atlanta, Ga., of which company he is auditor. He will retain his connection with the Michigan United Railways as treasurer and will continue to reside in Jackson.

Mr. Edwin E. Witherby, who was recently appointed Western manager of the General Vehicle Company with headquarters in Chicago, was formerly head of the E. E. Witherby Company, a New York corporation controlling five different gas and electric properties. He was responsible for the organization of the United Gas & Electric Company and was identified for years with the Susquehanna Railway, Light & Power Company. He is a member of the National Electric Light Association, American Gas Institute, American Institute of Electrical Engineers, the Indiana State Gas Association, the New England Association of Gas Engineers and the Society of Gas Lighting.

Mr. Albert Jackson Marshall, who has affiliated with Mr. F. Laurent Godinez in consulting lighting work, has long been identified with illuminating engineering activities. Beginning with the Baltimore branch of the Welsbach company, Mr. Marshall has been continuously active in the lighting industry, his later exertions having been on behalf of the Holophane company, with which he was connected for seven years. He has delivered many lectures on illuminating engineering subjects in the interests of both the Welsbach company and the Holophane company, before both gas and electric lighting engineers. For a time he served as chief engineer of the engineering department and subsequently as manager of the architectural department of the Holophane company. Mr. Marshall was a charter member, was for many years secretary of the New York Section and is at present director of the Illuminating Engineering Society. He is chairman of the illumination committee of the National Commercial Gas Association and an associate member of the American Institute of Electrical Engineers and of the Association of Car Lighting Engineers.

Obituary

Mr. W. E. Athern, engineer of equipment of the Western Union Telegraph Company, who died on May 29, was directly responsible for many inventions in telegraphy, although he never received public recognition or appreciation of his work. He invented the duplex system for use, by means of the "composite," in simultaneous telephone and telegraph transmission. He also invented and developed the present standard telegraph repeaters. He was for a time employed in the engineering and plant departments of the American Telephone & Telegraph Company, New York.

Mr. E. H. Keating, formerly city engineer of Toronto, Can., and later general manager of the Toronto Railway, died on June 18 at his home in that city. Mr Keating was a native of Halifax, N. S. He was educated at the Dalhousie University and the Chicago Academy and studied engineering under Mr. George Whiteman, provincial government engineer of Nova Scotia, and Sir Sandford Fleming. It was while city engineer of Duluth that Mr. Keating was invited to become city engineer of Toronto, which position he held from 1892 to 1898. In 1898 Mr. Keating was appointed general manager of the Toronto Railway and continued in that position until 1904. From Toronto he went to Mexico as managing engineer for the MacKenzie-Mann interests, and for the past seven years he had been engaged in private practice in Toronto. He was a past president of the Canadian Society of Civil Engineers, a member of the American Society of Civil Engineers and a member of the Engineers' Club of Toronto.

Construction

EUFAULA, ALA.—A franchise has been granted to the Pioneer El. Lt. Co. to construct and operate electric light, ice and gas plants.

FORT PAYNE, ALA.—Plans are being prepared by the Little River Pwr. Co., Nashville, Tenn., for the construction of three hydro-electric developments, having a total output of 150,000 hp. The first will be built on the Little River, near Fort Payne, where 50,000 hp will be developed. Electricity generated at this plant will be transmitted to Anniston, Gadsden, Huntsville and other localities.

GADSDEN, ALA.—Preparations are being made by the Noccalula Ry., Lt. & Pwr. Co. for the construction of an electric railway from Gadsden to Noccalula Falls, a distance of 3½ miles. Louis Hart, Gadsden, is interested.

HALEYVILLE, ALA.—At an election held June 17 the citizens voted to issue $5,000 in bonds for a lighting system and $15,000 in bonds for water-works. M. S. Drewry is city clerk.

MONTGOMERY, ALA.—The Montgomery Lt. & Pwr. Co. has filed a notice of increase in capital stock from $1,000,000 to $2,000,000. The company, it is understood, will make improvements to its electric railway system in Montgomery.

GLENDALE, ARIZ.—The Council has passed an ordinance providing for a bond issue of $9,000 for the construction of a municipal electric-light plant.

KINGMAN, ARIZ.—Plans are being made by E. H. Dickie, Monrovia, Cal., operating in the Silver Creek district, near Kingman, for the installation of an electric hoist.

PRESCOTT, ARIZ.—The Climax Mining Co. is contemplating the installation of an electric power plant to operate the machinery in its mines and mill. R. M. Martin is president.

LITTLE ROCK, ARK.—Work will soon be begun by the Little Rock Ry. & El. Co. on improvements to its system, including double-tracking the Highland Park line and installation of additional equipment in the power house, to cost about $20,000. A 6000-ft. condenser and an 18-in. motor-driven centrifugal pump will be purchased, together with other pumps, etc. Plans are also being considered for placing the wires underground in the business district, at a cost of from $150,000 to $170,000.

OLA, ARK.—Ira and G. W. Micks have been granted a franchise to construct and operate an electric-light plant in Ola.

DAVIS, CAL.—The Pacific Gas & El. Co. is building an addition to its new substation here to provide room for two machines to handle 4000-volt, single-phase current for the Southern Pacific Co.'s block signal system east and west of here. The electric company is also erecting a transmission line east from Woodland to the substation that will supply power to the Vallejo Northern Railroad.

GRIMES, CAL.—A petition is being circulated to be presented to the Board of Supervisors to call a special election to vote on the proposition to form a lighting district in Grimes.

HOLTONVILLE, CAL.—The Holton Pwr. Co. has applied to the State Railroad Commission for permission to issue $300,000 in bonds, the proceeds to be used for construction work.

MARYSVILLE, CAL.—Arrangements are being made by the Oro El. Lt. & Pwr. Co. to supply electricity here. A new distributing system will be installed.

NEWPORT BEACH, CAL.—The City Council is considering the question of calling a special election to vote on the proposition to issue bonds for the construction of an electric-light plant and a gas plant.

REDLANDS, CAL.—Investigations are being made of the power rights in Mill Creek Canyon offered to the city by C. G. Baldwin for $75,000. A municipal electric light and water system may be established.

SAN FRANCISCO, CAL.—The Ocean Shore R. R. Co. has been notified by the Public Utilities Committee to discontinue the use of steam locomotives within the city limits. It is expected it will equip its city trackage soon for electrical operation.

SEBASTOPOL, CAL.—The Pacific Gas & El. Co. has notified the Board of Trustees that if it is awarded the contract for furnishing electricity for lamps and motors the entire town will be rewired and a new system installed.

TULARE, CAL.—The Tulare County Pwr. Co. has applied to the State Railroad Commission for permission to raise funds to generate and distribute electricity in the western part of Tulare County.

BOULDER, COL.—The City Council has awarded the O'Brian Construction Co., Boulder, the contract for the construction of a municipal lighting plant. The contract calls for the construction of a large dam at Silver Lake, which will furnish power to operate the system.

DENVER, COL.—Investigations are being made by the engineers of the Denver & Rio Grande R. R. Co. to determine the feasibility of equipping the lines of the system over the mountain passes for electrical operation. The construction of the detour line over Soldiers' Summit, Utah, has been held in abeyance pending the outcome of investigations.

PUEBLO, COL.—Negotiations are under way between the city commissioner and the Pueblo & Suburban Trac. & Ltg. Co. for the installation of electric lamps in Mineral Palace Park and City Park.

EAST LONGMEADOW, CONN.—The citizens have voted to authorize the Selectmen to enter into a contract with the Massachusetts Central Ltg. Co., Palmer, for lighting the streets. The contract calls for 90 lamps at $17.50 each per year.

MYSTIC, CONN.—The Westerly Lt. & Pwr. Co. is planning to erect a brick substation in Mystic to replace the one recently destroyed by fire.

WASHINGTON, D. C.—The Washington & Great Falls Ry. & Pwr. Co. is contemplating the construction of an electric railway from Wisconsin Avenue to the Great Falls of the Potomac, a suburb near Washington. The company also proposes to erect a power station and to establich an amusement park at Great Falls.

WASHINGTON, D. C.—The American consulate-general at Sydney, Australia, has forwarded copies of tender forms, specifications, etc., covering various telephone supplies, including switchboards, accessories, etc., issued by the Postmaster-General's Department of the Commonwealth of Australia. Copies of papers referred to will be loaned to parties interested on application to No. 8902, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C. Tenders for the above materials will be received until July 31.

WASHINGTON, D. C.—An American consul has forwarded a copy of a concession granted by the local government to a business firm for constructing a dry dock and ship-building plant, the latter to consist of machine shop, electric cranes, marine railways, etc., boiler shops, power house with its electrical equipment and all other necessary equipment. The company is not to expend less than $6,000,000. Copy of the complete report will be sent upon request to No. 9042, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

LAKE BUTLER, FLA.—The Lake Butler Ice Co. contemplates the construction of an electric light plant. H. J. Smith, Tarpon Springs, is interested.

ATLANTA, GA.—The Central Georgia Trans. Co. has been granted permission to erect a trunk power line from the main plant in Atlanta to a substation to be built in East Point.

CLAXTON, GA.—The city is considering plans for the construction of a municipal electric-light plant.

GREENSBORO, GA.—Prominent business men are considering the question of securing electricity from the large power plant on the Ocmulgee River. Electricity generated at the plant is distributed by the Central Georgia Pwr. Co., Macon, Ga.

GUYTON, GA.—The Effington Lt. & Pwr. Co. is planning to install an electric-light plant in Guyton, to cost about $5,000. Louis Brown, P. O. box 77, Savannah, Ga., is interested in the company.

HARTWELL, GA.—Clarence Linder, vice-president of the People's Bank, is planning a water-power development to furnish electricity for lamps and motors. He also proposes to apply for a municipal lighting franchise.

BONDVILLE, ILL.—The installation of an electric-light plant here is under consideration. It is proposed to organize a company to operate it.

PARIS, ILL.—The finance committee of the City Council, which asked for bids for a municipal lighting plant, has reported unfavorably upon the proposition provided satisfactory arrangements can be made with the Paris Gas & El. Lt. Co. New bids have been asked for street lighting.

SHELBYVILLE, ILL.—Plans are being considered for wiring the county fair grounds and buildings and to light the entire grounds by electricity.

SPRINGFIELD, ILL.—The Springfield Pleasure Driveway and Park District has closed a contract with the Springfield Lt., Ht. & Pwr. Co., whereby the latter will install an ornamental street-lighting system, at a cost of $19,000, and furnish electricity for lighting the parks and boulevard at $16.11 per lamp per year on an all-night schedule.

STERLING, ILL.—The Illinois Northern Utilities Co. is planning to extend its transmission line from Sterling to Morrison, Tampico and Erie.

WATSEKA, ILL.—The Board of Supervisors of Iroquois County has granted the Central Illinois Utilities Co. a franchise to erect a transmission line from Watseka along the highways of the county. The proposed line will supply electricity in Crescent City, Gilma, Onarga, La Hogue and other localities.

BLUFFTON, IND.—Prof. C. Francis Harding, of Purdue University, has been retained as consulting engineer to make complete appraisal and estimate of necessary improvements on the municipal electric light and power plant in Bluffton.

FORTVILLE, IND.—At a special election held June 18 the proposition to install a water and light plant was carried. It is stated that plans will be prepared at once for the plant and contracts for construction and machinery awarded as soon as possible.

GOSHEN, IND.—In a general report submitted to the City Council, Orlando Hamilton, superintendent of the city water-works and light plant, states that the electric plant should be reconstructed or repaired. He also recommends substituting an inclosed-arc lighting system for the present arc lamps.

LAPORTE, IND.—The United Lt. & Rys. Co., incorporated under the laws of Maine with a capital stock of $12,000,000, has filed articles of incorporation and been granted a charter to do business in Indiana. The new company has taken over the Laporte Elec. Co., Laporte, and is preparing to take over other companies. William A. Martin, of Laporte, is president, and L. H. Henike, of Grand Rapids, Mich., secretary.

LEBANON, IND.—The Citizens' El. Lt. & Ice Co. has purchased the property of the Lebanon Htg. Co. and plans are being prepared for merging the two plants. New equipment will be installed, including a turbine engine. Steam from the heating plant will be used to operate the power plant. Plans are being prepared by the W. H. Schott Co., Chicago, Ill.

MARTINSVILLE, IND.—The Alliance Engineering Co., Cincinnati, Ohio, is reported to have purchased the property of the Martinsville Lt., Ht., Pwr. & Wtr. Co. The property will be taken over by the new owners July 1.

MITCHELL, IND.—The City Council is contemplating the installation of an engine and generator in the municipal electric light plant.

SHERIDAN, IND.—The City Council is planning to install an electric distributing system. A transmission line will be erected from Noblesville, a distance of 11 miles, where electricity will be secured to operate the system.

TERRE HAUTE, IND.—The Vigo El. Co., former owner of the electric lighting plants at West Terre Haute, Brazil and Greencastle, which were recently purchased by the J. P. Morgan syndicate, has also sold all its holdings in coal lands, mines, etc., in Sugar Creek Township to the Fauvre Coal Co., Indianapolis. It is expected that the new syndicate will compete for the lighting contract in Terre Haute and that a new interurban railway will be extended to Terre Haute from the west.

CHARLES CITY, IA.—The City Council has awarded the contract for street lighting to the Charles City Lt. & Ht. Co. Under the terms of the contract twenty-six ornamental lamp standards will be installed.

DAVIS CITY, IA.—The Herald Publishing House, of Lamoni, has submitted a proposition to the Council offering to extend its transmission line from its power house in Lamoni to Davis City, provided a franchise is granted and sufficient patronage is guaranteed. A special election will be held July 1 to vote on the proposition.

FORT DODGE, IA.—The capital stock of the Fort Dodge Tel. Co. has been increased from $100,000 to $300,000.

GARWIN, IA.—The Council has granted J. P. Walters, secretary of the Tama & Toledo El. Ry. & Lt. Co., Toledo, a franchise to supply electricity for lamps and motors here.

HOPKINTON, IA.—W. A. Milroy, owner of the local electric-light plant, is contemplating extensive improvements to system. The City Council is considering the question of installing a new street-lighting system. Electroliers may be erected in the business section.

KEOKUK, IA.—Plans have been approved by the Stone & Webster Engineering Corpn., Boston, Mass., for the construction of a new substation for the Keokuk El. Ry. & Pwr. Co., to be located at Ninth and Phelean Streets, to cost approximately $100,000. The new plant will have an output of 110,000 hp.

MERRILL, IA.—Steps have been taken by local business men for the installation of a municipal electric-light plant.

MOUNT VERNON, IA.—At an election held recently the proposition to grant a franchise to the Cedar Rapids & Iowa City Ry. & Lt. Co. was carried.

NEVADA, IA.—Plans are being considered for the installation of an ornamental street-lighting system here.

SHELLROCK, IA.—An electric-light franchise has been granted to Uri and William Richards.

WOODBINE, IA.—E. A. Bullock, of the Iowa-Nebraska Public Service Co., of Missouri Valley, has applied to the Council for a franchise to supply electricity in Woodbine.

ATCHISON, KAN.—Work will soon begin on improvements to the electric plant of the Atchison Ry., Lt. & Pwr. Co., at Tenth and Main Streets, to cost about $35,000. A new building 25 ft. x 130 ft. will be erected, new boilers and 750-kw direct-connected generating unit installed. All machinery has been purchased. J. W. Waggener is local manager.

AXTELL, KAN.—The town of Axtell is contemplating erecting a transmission line to Seneca to secure electricity to operate the proposed municipal electric light and power system. Bonds to the amount of $10,000 were voted to establish a plant.

BURLINGTON, KAN.—The Commercial Club is promoting the installation of an ornamental street-lighting system for the principal streets.

OSBORNE, KAN.—Arrangements are being made by the City Council for the reconstruction of the local electric-light plant, recently purchased by the city. The system will be changed from direct-current to alternating-current. Tungsten lamps will be used for street lighting.

TOPEKA, KAN.—Bids will be received by the city clerk until July 1 for the installation of the ornamental street-lighting system on East Fourth Street from Kansas Avenue to Holliday Street. Several extensions to the system are under consideration.

WILLIAMSBURG, KAN.—Work will begin on the construction of the municipal electric-light plant about July 15, for which bonds to the amount of $5,000 were recently voted. I. C. Bushong, of Ottawa, engineer, has been engaged to take charge of the work.

LEITCHFIELD, KY.—Preliminary arrangements have been completed by the Leitchfield El. Lt., Ht. & Pwr. Co. for the construction of an electric-light plant here. W. T. McClaskey, S. F. Seager and others are interested.

LEXINGTON, KY.—The Transylvania University is contemplating the construction of a central heating and power plant in connection with the university, to cost about $100,000. R. H. Crossfield is president.

MARION, KY.—The Marion El. Lt. & Ice Co. is contemplating the installation of additional machinery. S. M. Jenkins is president.

SIMPSONVILLE, KY.—The Lincoln Industrial Institute contemplates the installation of an electric light and power plant, to cost approximately $10,500. A. E. Thompson is president.

TAYLORSVILLE, KY.—The installation of an electric-light system is under consideration.

JENA, LA.—Plans are being prepared for the installation of an electric-light plant and ice factory in Jena, to cost about $25,000. H. W. Wright and C. C. O'Malley, Winnfield, are interested.

NEW ORLEANS, LA.—The New Orleans Ry. Co. has submitted a proposition to the Sewerage and Water Board offering to supply electricity to operate the water plant and the drainage and sewage-pumping stations.

AMESBURY, MASS.—The Amesbury El. Lt. Co. has petitioned the State Gas and Electric Light Commissioners for permission to issue $14,700 additional capital stock, the proceeds to be used for extensions to plant.

BOSTON, MASS.—Bids will be received by Manus J. Fish, superintendent of public buildings, 100 Summer Street, Boston, until July 1 for furnishing and installing electrical work in an office building, the annex to the city hall. Copy of plans and specifications may be obtained at the office of Edward T. P. Graham, architect, 20 Beacon Street, Boston. A deposit of $25 will be required for each set of drawings and specifications.

DIGHTON, MASS.—The Fall River El. Lt. Co. is planning to extend its transmission lines to Dighton, where it has recently been granted a franchise.

GREENFIELD, MASS.—The Greenfield El. Lt. & Pwr. Co. is planning to install a 750-kw generating unit, consisting of waterwheel and generator.

HINSDALE, MASS.—The Eureka El. Co., Pittsfield, is making investigations in Hinsdale with a view of furnishing electricity for lamps and motors here. It is proposed to extend the transmission line from Dalton to supply the service. Electricity for operating the system will be furnished by the Pittsfield El. Co., Pittsfield.

NORTH ADAMS, MASS.—Interests connected with the power development of the Deerfield River at the east side of Florida Mountain have secured rights of way over the mountain to North Adams and to the power station at Zylonite.

WESTFIELD, MASS.—The Municipal Lighting Department is planning to substitute electric incandescent lamps for arc lamps now in use in the residential sections.

WINTHROP, MASS.—The committee appointed by the town to investigate the advisability of municipal ownership of a gas and electric plant has recommended that the town should not acquire a plant at the present time and recommends that a new contract be made with the Suburban Gas & El. Co.

WORCESTER, MASS.—The City Council committee on street lighting has recommended the erection of 46 luminous arc lamps on Front Street between Main and Washington Streets. Tungsten lamps for all bridges under the railroad locations on streets that cross under the "Chinese wall" were also recommended.

CENTERVILLE, MICH.—The capital stock of the Centerville Wtr. & El. Co. has been increased from $10,000 to $75,000.

MERRILL, MICH.—The Consolidated Lt. & Pwr. Co. has been granted a 30-year franchise to furnish electricity in Merrill. J. L. Hudson, of Detroit, is interested in the company.

SAGINAW, MICH.—The Saginaw Pwr. Co. has submitted a proposition to the special committee on improved street lighting in the East Side business district. The plans include replacing the present arc lamps with tungsten lamps to be erected on ornamental standards, each carrying five-lamp clusters. Under the present plan 186 standards, at a cost of $150 each, will be erected. The company offers to install the system and maintain the lamps for 8 cents a front-foot per month, or at annual cost of about $7,000 under a five-year contract.

BIG FALLS, MINN.—The Big Falls Mfg. Co. is planning to erect an electric-light plant and heading mill in Big Falls, work on which will begin in about 30 days.

DASSELL, MINN.—The electric-light company has purchased the poles and wire of the Northwestern Telephone Exchange Co.

DULUTH, MINN.—Bids will be received by F. E. Hough, city electrician, 608 West First Street, Duluth, until July 3, for 5700 ft. of lead-covered cable, 14 conductors, No. 14 B. & S. gage copper wire, 5/32-in. rubber insulation bunched and finished with 5/64-in. lead sheath.

EAST GRAND FORKS, MINN.—The Red River Pwr. Co., Grand Forks, N. D., is planning to erect a substation here, the equipment to include a six-panel switchboard and motor-generator set. The local electric lighting system will be reconstructed.

VIRGINIA, MINN.—The City Council has voted to offer to the Virginia Wtr. & Lt. Co., $404,000 plus 10 per cent for its plant. The company recently offered the plant to the city for $550,000.

LOUISVILLE, MISS.—The construction of an electric-light plant here is under consideration. W. C. Hight and J. L. McCracken are interested in the project.

INDEPENDENCE, MO.—The property owners on Maple Avenue have organized under the name of the Independence State Highway Association and have agreed to erect an ornamental street lighting system on the avenue.

ST. LOUIS, MO.—A meeting of the stockholders of the Southern Trac. Co. will soon be held to vote on an increase of capital stock from $1,500,000 to $7,500,000. The company also proposes to issue $7,500,000 in bonds, the proceeds to be used to build terminal facilities in St. Louis and East St. Louis and to construct a railway from East St. Louis to Duquoin, a distance of about 80 miles.

ARLINGTON, NEB.—If granted a franchise, E. V. Capps will take over the plant of the Arlington El. Lt. Co. If the change is made, Mr. Capps advises the installation of tungsten lamps for street lighting.

BEATRICE, NEB.—Improvements are contemplated by the Beatrice El. Co. involving an expenditure of about $25,000. They will include the construction of a power house, new machinery, transformers, etc.

HASTINGS, NEB.—Preparations are being made to begin work on the installation of underground conduits for the ornamental street-lighting system about July 1.

RISING CITY, NEB.—The village of Rising City is planning to install an electric-light plant and water-works system, to cost about $8,000. Bids for the work will be received until July 5. The Alamo Engine Co., Omaha, has charge of the engineering work.

GARDNERVILLE, NEV.—The Douglas Milling & Pwr. Co. has applied to the County Commissioners for a franchise to erect and maintain transmission lines over, under and across the public roads and highways in Douglas County.

WINNEMUCCA, NEV.—The Winnemucca Wtr. & Lt. Co. has submitted a proposition to the County Commissioners offering to sell its plant to the town of Winnemucca for $175,000. A special election will soon be called to submit the proposition to a vote.

WOLFBORO, N. H.—The town has voted to build a new electric light plant on Factory Street, the cost not to exceed $15,000. D. S. Boyden is consulting engineer.

ATLANTIC CITY, N. J.—The Council has granted the Venice Park El. Ry. Co. a franchise to extend its railway to a junction with the fast shore line by the way of Ohio Avenue.

PLAINFIELD, N. J.—The City Council has authorized a new street-lighting contract with the Public Service Corporation for a period of five years. The contract provides for 20 arc lamps of 2000 cp, 400 incandescent lamps of 32 cp and 611 lamps of 25 cp.

DEXTER, N. M.—Application has been made to the Town Board by N. S. Sweeney and C. R. Beck, of this city, for a franchise to install and operate an electric-light plant here.

AMSTERDAM, N. Y.—Julius Kayser & Co., operating silk mills, are planning to enlarge their power plant. An addition 120 ft. long will be erected to the boiler house, to provide space for new boilers to be installed.

BUFFALO, N. Y.—The City Council has authorized the construction of a brick power house and forge shop, including mechanical equipment, to be used in connection with the Peckham Street Vocational School.

CENTERPORT, N. Y.—Taxpayers have petitioned the Town Board to establish a lighting district in this village, covering the principal residential sections.

COHOCTON, N. Y.—The Wayne Pwr. Co. has been granted permission by the Public Service Commission to issue $10,000 in capital stock and $105,000 in bonds, the proceeds to be used for the construction of a transmission line from Wayland to Avoca, Atlanta, Cohocton and Wallace, a distance of 21 miles; also for the erection of necessary substations, apparatus and distributing systems in these places.

FREEPORT, N. Y.—The Board of Village Trustees has voted to issue $25,000 in bonds for improvements and extensions to the municipal electric-light plant.

FULTON, N. Y.—Plans have been completed by the American Woolen Co. for the construction of a hydroelectric plant, to cost approximately $300,000. J. W. Stevenson is interested.

GILBOA, N. Y.—The Public Service Commission has authorized the Tri-County Lt. & Pwr. Co. to exercise franchises granted for furnishing electricity for lamps, heat and motors in Gilboa. The commission has also authorized the company to issue capital stock to the amount of $5,000 and $60,900 in bonds, the proceeds to be used for construction of dam, power house, electrical apparatus, etc., and also for the erection of a transmission line from Gilboa to Stamford, a distributing system in Gilboa and a transmission line in Grand Gorge.

ILION, N. Y.—The installation of an ornamental street-lighting system is under consideration. Several standards, carrying five-lamp clusters, have been erected for experimental purposes.

PHILMONT, N. Y.—The Philmont Ltg. & Pwr. Co. has applied to the Public Service Commission for permission to erect transmission lines to supply electricity for lamps and motors in the town of Philmont and Claverack.

ROCHESTER, N. Y.—The Board of Contract and Supply has directed Secretary Frank X. Pifer to advertise for bids for lighting the streets of the city by electricity for a period of five years, beginning July 1.

SCOTIA, N. Y.—The Village Board has awarded the contract for the new lighting system. The contract calls for 128 tungsten lamps.

TROY, N. Y.—Plans are being considered for the installation of an ornamental street-lighting system in the business district.

GREENSBORO, N. C.—The North Carolina Pub. Ser. Co. is contemplating improvements to its plants in Salisbury and Spencer, involving an expenditure of about $75,000.

MURPHY, N. C.—Plans are being prepared by the Carolina-Tennessee Pwr. Co., New York, for a hydroelectric power development on the Hiwassee River, near Murphy. The plans call for construction of two dams 150 ft. high and 1200 ft. long on crests and the erection of transmission lines to copper smelters at Ducktown, Tenn

NEWTON, N. C.—John C. Yount, of Newton, contemplates the construction of a hydroelectric power plant.

REIDSVILLE, N. C.—The American Tobacco Co. is planning to erect a power plant in Reidsville. The main office of the company is located at 200 Fifth Avenue, New York, N. Y.

ROLLA, N. D.—Investigations are being made by Robert Long, of Hansboro, with a view of establishing an electric-light plant here.

CLEVELAND, OHIO.—Bids will soon be called for material necessary to start work on the construction of the municipal electric-light plant. The cost of the plant is estimated at about $900,000. Fred W. Ballard is engineer in charge.

DEFIANCE, OHIO.—Plans have been completed for the steam auxiliary power plant of the Auglaize Pwr. Co., to cost about $200,000, by R. R. Livingston, New York, N. Y., architect. Contracts for construction of building and equipment will soon be awarded.

TOLEDO, OHIO.—The Toledo Rys. & Lt. Co. has submitted a proposition to Service Director Crowell offering the city the use of its abandoned power plant at Locust and Water Streets for a high-pressure pumping station, provided the city will pay all the expense of remodeling and repairing the building and pay the taxes on the property. F. R. Coates is president.

WARRENSVILLE, OHIO.—Sealed proposals will be received by Charles W. Stage, director of public safety, Room 109, City Hall, Cleveland, Ohio, until July 8 for furnishing material and installation of wiring in the buildings of the infirmary group, Cooley Farms, Warrensville. Plans and specfications may be seen at the office of J. Milton Dyer, architect, 825 Cuyahoga Building, Cleveland.

MUSKOGEE, OKLA.—Plans are being prepared by the Muskogee Wtr. Pwr. Co. for the construction of a large hydroelectric power plant on the Grand River, near Muskogee, to be reinforced by two auxiliary plants, one to be erected on Carey Island, the second auxiliary to be for future development and the third plant to be located on the Illinois River, 20 miles distant. Electricity generated at this plant will be transmitted to the central power plant located on the Grand River. W. H. Rosecrans Engineering Co., 30 La Salle Street, Chicago, Ill., has charge of the engineering work. S. P. Mann is president.

BEND, ORE.—The Bend Wtr., Lt. & Pwr. Co. is contemplating the construction of an electric power plant, to cost about $80,000. The initial installation will include two units.

EUGENE, ORE.—The Oregon El. Ry. Co. contemplates the construction of an electric railway from Eugene to Pleasant Hill, a distance of about 10 miles.

HOOD RIVER, ORE.—It is reported that plans are being considered for equipping the Mount Hood steam railroad for electrical operation and the construction of an electric railway from Hood River to Lost Lake. Several power sites have been either purchased or located.

KLAMATH FALLS, ORE.—Plans are being considered for the construction of an electric railway from Klamath Falls to Bonanza Valley, a distance of 28 miles. The cost is estimated at about $12,000. George C. Clark, W. Paul Johnson, C. E. Moore and others, of Klamath Falls, are interested.

VALE, ORE.—The Department of the Interior has approved the application of W. F. Homan for a power site on the Payette River. Mr. Homan proposes to develop the water-power to generate electricity which will be transmitted to the Dead Ox Flat country, a distance of 60 miles. It will be used for pumping water from the Snake River to irrigate about 60,000 acres.

CRESSON, PA.—Bids will be received until July 8 for furnishing and installing power-plant equipment for the State Sanatorium for Tuberculosis, near Cresson, Cambria County, for the Commonwealth of Pennsylvania, Department of Health. Plans and specifications can be obtained of Dr. Samuel G. Dixon, commissioner of health, either at his Philadelphia office, 1900 Race Street, or at his Harrisburg office, for which a deposit of $25 will be required.

HERNDON, PA.—The Herndon El. Co. has applied to the Town Board for a franchise to construct and operate an electric-light and power plant.

MAHANOY, PA.—Bids will be received by the People's Lt., Ht. & Pwr. Co. until July 1 for reconstruction and extension to its substation in Mahanoy City. The Scofield Engineering Co., Philadelphia, Pa., consulting engineer, has charge of the work.

MEYERSDALE, PA.—The report submitted by Sidney B. Martin, Pittsburgh, consulting engineer, to the Borough Council regarding the installation of a municipal electric-light plant estimates the cost at about $32,000; the cost of operating the plant would be about $9,735 and the receipts $15,817. The proposed plant would provide for 50 arc lamps instead of the 39 now in use. Steps will be taken to submit the proposition to establish a municipal plant to a vote.

PHILADELPHIA, PA.—Plans have been completed by John T. Windrim for a station for the Philadelphia El. Co., to be erected on Ramstead Street, between Twentieth and Twenty-first Streets. The building will be 110 ft. x 90 ft. and will be known as station F.

PHILADELPHIA, PA.—Proposals will be received at the office of the director of the Department of Public Safety, Room 215, City Hall, Philadelphia, until July 1, for combination electric and gas fixtures, etc., and electrical wiring materials for new police station and fire house, located at corner of Fifty-fifth Street, Philadelphia. Specifications may be secured at the office of the electrical bureau, Room 618, City Hall. George D. Porter is director of the Department of Public Safety.

PITTSBURGH, PA.—The City Council has passed an ordinance granting a franchise to the Pennsylvania Lt., Ht. & Pwr. Co. to supply electricity in the first 20 wards of the city. The company already has a franchise on the North Side.

PITTSTON, PA.—The City Council is considering the question of installing a municipal electric-light plant.

SHARON, PA.—The City Council has rejected the proposition of the Mahoning & Shenango Ry. & Lt. Co. and has decided to proceed with the construction of a municipal electric-light plant.

SHARON, PA.—The National Malleable Iron Co., Sharon, has closed a contract with the Republic Ry. & Lt. Co. for electrical power to operate its works. It is said that a number of large steel and iron plants in the Youngstown and Sharon districts contemplate purchasing electrical power from the Republic Ry. & Lt. Co. To supply this demand and to secure additional power for its own use the company is to erect a central station at Lowellville, at a cost of $1,500,000.

PROVIDENCE, R. I.—The Narragansett El. Ltg. Co. has begun work on the construction of a substation to be located on Roger Williams' Avenue, to distribute electricity in that section of the city.

SPARTANBURG, S. C.—The City Council has granted a franchise to J. P. Wood to install and operate an electric-light plant.

HALLS, TENN.—The property of the Halls Lt., Wtr. & Ice Co. has been purchased by James Z. George, of Memphis, Tenn. Extensive improvements will be made to the system, including the installation of a new dynamo, enlarging the capacity of the ice plant and laying new water mains.

KNOXVILLE, TENN.—The Tennessee Exploration Co., it is reported, is considering plans for the construction of a hydroelectric power plant on Holston River for the purpose of generating electricity to operate a large zinc factory which it contemplates building in Mascot, Tenn.

SPARTA, TENN.—The Great Falls Pwr. Co. has purchased the property of the Anderson & Tubb Pwr. Co., the Sparta Wtr. Co. and the Sparta El. Lt. Co. The systems will be operated by electricity generated at the falls.

DALLAS, TEX.—Plans and estimates are being prepared by Leon Taylor, city electrician, for a municipal electric-light plant. It is proposed to submit the question to a vote.

DALLAS, TEX.—The State Department has granted the Phoenix Constr. Co., of Hartford, Conn., a permit to do business in Texas. This company will do the construction work for the Texas Lt. & Pwr. Co., recently incorporated with a capital stock of $13,000,000. A central power plant is to be erected at Waco, to cost about $2,000,000.

GALVESTON, TEX.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 16 for extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits, wiring system and lighting fixtures, of the United States appraiser's stores, Galveston. Plans and specifications may be obtained at the above office or at the office of the custodian, Galveston.

GROESBECK, TEX.—The Groesbeck Lt. Co. has sold its plant to Ennis parties. The new owners are planning to establish a day service and to build an ice factory this summer.

PALESTINE, TEX.—Plans are being considered for the installation of an ornamental street-lighting system in the business district, to cost about $2,000.

PORT ARTHUR, TEX.—Preparations are being made by the Stone & Webster Engineering Corpn., Boston, Mass., for the construction of an electric railway between Beaumont and Port Arthur. It proposes to take over the light and power plant and operate the plant and railway system under one corporation.

ROCKPORT, TEX.—The local electric light and power plant and ice factory has been purchased by D. E. Savage and associates. Improvements will be made to the electric plant and new machinery installed, at a cost of about $40,000. The new owners will also install a foundry and machine shops.

TEXAS CITY, TEX.—The Texas City Terminal Co. is contemplating the construction of an electric street-railway system here.

OGDEN, UTAH.—The Town Board has voted to install an electric street-lighting system here. The service will be supplied by the Illinois Trac. System.

OGDEN, UTAH.—The Southern Pacific Co. has appropriated $125,000 for the installation of an alternating-current automatic block signal system across the Lucin cut-off. The proposed work calls for the installation of the alternating-current system for a distance of 20 miles across the fills in Salt Lake on the east side of the trestle and approximately 24 miles on the west side of the trestle. Electricity for operating the system will be supplied from the Southern Pacific shops at Ogden. A special power plant will be erected at Lemey, Utah, to provide power for the west end of the system.

SPOKANE, WASH.—The Spokane & Inland R. R. Co. is planning to build an extension from Colfax to Pullman, Wash., a distance of about 15 miles. The Northern Pacific railroad will be equipped for electrical operation from Pullman to Genesee, Idaho, and an electric railway constructed from Genesee to Lewiston, Idaho. The cost of the work is estimated at about $1,500,000.

BLUEFIELD, W. VA.—The Appalachian Pwr. Co., which was organized to develop five water-power sites on the New River, aggregating 75,000 hp, expects to have one of these developments, of 10,000 hp, in operation by Aug. 1, and the second, of 19,000 hp, by Oct. 1. The company has placed contracts with the Roanoke Ry. & Lt. Co., the Pocahontas Consolidated Collieries Co., the Virginian-Pocahontas Coal & Coke Co., the American Coal & Coke Co., the Zenith Coal & Coke Co., the Crystal Coal & Coke Co., the West Virginia-Pocahontas Co., the Coal Dale Mines and other mines in the Pocahontas coal field. In addition the company has acquired the electric lighting, railway and power systems in the towns of Marion, Wytheville, Pulaski, Bluefield, Pocahontas, Welch and Keystone, all within 50 miles of the power development. The present plants will be closed down and electricity supplied from the hydroelectric plants. High-tension transmission lines are now being erected to the Pocahontas field, Bluefield and Roanoke. A line will also be constructed to Martinsville and Danville to the southeast and to Saltville.

APPLETON, WIS.—The Wisconsin Trac., Lt., Ht. & Pwr. Co. is planning extensions to its gas and electric plants, including the installation of new equipment, at a cost of about $50,000.

MADISON, WIS.—Sealed bids will be received by the secretary of the special building committee of the State Historical Society of Wisconsin until July 23 for the electrical work for the northwest wing of the State Historical Library Building. Plans and specifications may be obtained at the office of the secretary.

RACINE, WIS.—Sealed proposals will be received by the special building committee of the County Board of Supervisors, Racine County, Racine, addressed to C. E. Nelsen, county clerk, until July 8 for furnishing material and labor as follows: (a) general contract; (b) plumbing contract; (c) heating contract; (d) ventilating-fan equipment; (e) temperature regulation; (f) air washers; (g) vacuum heating system; (h) electric installation contract; (i) vacuum cleaning equipment, for court house building to be erected in Racine. Plans and specifications are on file at the office of Bell, Tyrie & Chapman, architects, 320 Auditorium Building, Minneapolis, Minn., and at the office of the county clerk. Plans and specifications may be obtained from the architects, for which a deposit of $50 will be required for general contract, $35 to be refunded upon return of same; for contracts (b), (c), (d), (e), (f), (g) and (h) a deposit of $25 will be required, of which $15 will be refunded upon return of plans. Martin Christensen is chairman of committee.

RICE LAKE, WIS.—The Red Cedar Valley El. Co. has submitted a proposition to the Council offering to install an ornamental street-lighting system complete for $1,965. The company has also submitted a bid for pumping water for the city for a period of five years, upon the basis of the present equipment, with an additional electric pump at the city pumping plant to be furnished by the company, at $3,200 per annum.

PENTICTON, B. C., CAN.—Tenders will soon be asked by the Municipal Council for a 200-hp Diesel engine for the municipal electric-light plant.

BROCKVILLE, ONT., CAN.—The municipal gas and light committee has recommended that a number of additional electric incandescent lamps be erected, many of which will replace gas lamps now in use. J. H. Bryson is city engineer.

FORT FRANCES, ONT., CAN.—The City Council is considering the question of establishing a municipal electric-light plant. It is proposed to develop the Whitehorse Rapids, about 20 miles north of the town, which would be placed under the control of the Hydro-Electric Commission.

WOODSTOCK, ONT., CAN.—Sealed tenders will be received by N. E. Birtch, county clerk, Woodstock, until July 5 for wiring the county court house. Plans and specifications can be seen at the office of the county clerk.

VERDUN, QUE., CAN.—Sealed tenders will be received by G. A. Ward, secretary and treasurer, Town Hall, Verdun, until July 1 for furnishing and installing two 300-hp water-tube boilers. Specifications may be obtained on application to Henry Hadley, Jr., town engineer.

BATTLEFORD, SASK., CAN.—By-laws have been passed by the Council appropriating $100,000 for water-works, sewers and extension to the electric-light plant.

GUADALAJARA, JALISCO, MEX.—The Mexican Tel. & Teleg. Co. has been granted a concession by the city of Guadalajara to install an entirely new telephone system with underground wires throughout the city, to cost about $250,000. The company is planning to connect Vera Cruz on the east coast with Manzanillo on the west, giving long-distance service between the two cities, and connecting important cities between.

New Industrial Companies

THE AERO FIRE ALARM COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $100,000 by L. McKee, C. A. Hand and W. H. Brearley, Jersey City, N. J. The company proposes to manufacture automatic fire alarms, signals, etc.

THE AJAX INSULATED WIRE COMPANY, of Rowland Mills, N. J., has been incorporated with a capital stock of $150,000 to manufacture wire products. The incorporators are: F. J. Gardenshire, J. V. Bronn, New York; C. A. Wolle and G. W. Wolle, Bethlehem, Pa., and R. R. Beam, Newark, N. J.

THE ERIE ELECTRIC CONTRACTING COMPANY, of Bridgeport, Conn., has filed articles of incorporation with the Secretary of State. The officers are: Daniel P. Bergheimer, president; James A. Byrne, vice-president, and Peter C. Schutrum, secretary and treasurer, all of New York, N. Y.

THE HIRSCH ELECTRIC MINE LAMP COMPANY, of Camden, N. J., has been incorporated by J. A. MacPeak, C. U. Martin and F. R. Hansell, all of Camden. The company is capitalized at $300,000 and proposes to manufacture electric lamps, storage batteries, motors, etc.

THE HOBART ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $20,000 by A. T. Raynor, W. F. Runkle, Henry Hoppenburg, E. M. Hoppenburg and James Long.

THE KENT ELECTRICAL MANUFACTURING COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $5,000 by George Schuirmann, E. W. Bereiter and E. R. Ingersoll.

THE NATIONAL AUTOMATIC ELECTRICAL SUPPLY COMPANY, of New Orleans, La., has been chartered with a capital stock of $10,000 for the purpose of dealing in electrical supplies, etc. The officers are: Edwin H. McFall, president; Charles A. Thiel, vice-president, and Joseph R. Behrens, secretary and treasurer.

THE NEW JERSEY ELECTRIC PROTECTION COMPANY, of Newark, N. J., has been incorporated with a capital stock of $50,000 to deal in fire alarms by M. M. Mullin, 119 Plane Street; William P. Brady and Joseph Biddall, 776 Broad Street, all of Newark, N. J.

THE RIDER LAMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture lamps. The incorporators are: G. S. Rider, Brooklyn; F. Mathesius, Jr., and W. H. Fischer, New York.

New Incorporations

FLORENCE, ARIZ.—The Florence Improvement Co. has been incorporated with a capital stock of $300,000 for the purpose of operating an electric light and power plant, gas plant, water-works and electric street-car line in Florence. The directors are: R. G. Arthur and W. E. Williams, Douglas, Ariz.

LAKE VILLAGE, ARK.—The Lake Village Lt. & Pwr. Co. has been granted a charter with a capital stock of $7,000. R. B. Cloffett is president and John G. B. Sims secretary.

LITTLE ROCK, ARK.—The Little Rock & Argenta Ry. Co. has been incorporated by A. C. Read, M. W. Fleming, W. D. Cammack and S. L. White. The company is capitalized at $100,000 and proposes to build an electric railway from Little Rock to Argenta.

WILMINGTON, DEL.—The Continental Public Service Co. has filed articles of incorporation with a capital stock of $50,000,000 under the laws of the State of Delaware. The company is authorized to do a general utility business, construct and operate railways, electric-light and gas plants, etc. It is reported that the company will take over a number of public utility concerns. The incorporators are: E. E. McWhiney, William J. Maloney and Norman Coffin, all of Wilmington, Del.

ATLANTA, GA.—The Atlanta & Macon Railway Co. has been incorporated with a capital stock of $100,000 for the purpose of building an electric railway between Atlanta and Macon. The incorporators are: W. D. Seahan, Kennatt Cowan, S. Bullard, W. J. Massee, James M. Brannen and others.

CHICAGO, ILL.—The American Public Utilities Co., of Chicago, Ill., has filed articles of incorporation under the laws of the State of Delaware. It is capitalized at $40,000,000 and proposes to construct and operate natural gas, artificial gas and electric plants and street railway systems; also to manufacture globes, chandeliers, brackets, etc., and to form companies to do all kinds of business. The incorporators are: Paul A. Neuffer, Harry H. Phillips, Charles J. Horn and Burrell J. Cramer, all of Chicago, and William J. Maloney, of Wilmington, Del.

FORT WAYNE, IND.—The Chicago, Gary & Fort Wayne R. R. Co. has been incorporated in Indiana with a capital stock of $50,000 to build an electric railway 165 miles long to connect Fort Wayne, Warsaw, Plymouth, Laporte, Gary and intervening towns. The directors are: Alexander C. Miller, Chicago, Ill., president; F. H. Wood, L. E. Underwood, A. A. Miller and Charles W. Chase.

PARKER'S PRAIRIE, MINN.—The Eastern Farmers' Tel. Co. has been organized with a capital stock of $9,000. W. H. Smith is president and A. B. Rosenquist secretary of the company.

Trade Publications

LIGHTING FIXTURES.—A 7-in. x 9-in. card sent through the mails by the F. W. Wakefield Brass Company, Vermilion, Ohio, tells of its lighting fixtures in short, pointed sentences.

TRANSFORMERS.—The General Electric Company has issued an attractive bulletin, No. 4938, devoted to its type H transformers, which supersedes a previous bulletin on the same subject.

CONDUITS.—The Central Tube Company, Lewis Building, Pittsburgh, has issued a booklet in which are listed and described various forms of conduit for protecting electrical conductors.

CLUSTERS.—The F. Bissell Company, 226 Huron Street, Toledo, Ohio, is sending out a four-page folder on its "security" cluster, with an illustration, description, list price and distribution curve.

STEAM ENGINES.—A. L. Ide & Sons, Springfield, Ill., has issued Bulletin No. 20, in which their valve engine is briefly described and illustrated with many diagrams. The bulletin contains a page of specifications.

LABORATORY APPARATUS.—Circular No. 30,200 of the Holtzer-Cabot Electric Company, Brookline, Mass., has as its subject special apparatus for electrical laboratory demonstration, with illustrations and descriptions.

TURBINES.—The Kerr Turbine Company, Wellsville, N. Y., in its Bulletin No. 24 gives information with respect to the steam turbines for belt drive, illustrations and descriptions being included of two recent installations.

WATER HEATER.—The Cutler Heater Company, 143 Second Street, San Francisco, has issued illustrated catalogs devoted to electric water heaters ranging in output from 0.75 gal. per minute to 60 gal., kept hot continuously.

MOTORS.—Bulletin No. 18 of the Century Electric Company, Nineteenth and Olive Streets, St. Louis, Mo., refers to single-phase, constant-speed motors. The catalog is comprehensive and well illustrated, with a number of curves and diagrams.

SWITCHES.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., has issued Bulletin No. 25, showing cuts of its iron-clad fused switches in operation and also its three-phase motor starter. A price list is given on the fourth page of the folder.

STORAGE BATTERIES.—The Niagara Lead & Battery Company, Niagara Falls, N. Y., devoted its Bulletin No. 20 to stationary types for telephone, telegraph and other service. A number of tables containing essential data on the subject matter are included.

BOILER APPLIANCES.—Four four-page leaflets from the Pratt & Cady Company, Hartford, Conn., have as their subjects boiler safety appliances, regrinding swing check valves, globe and angle valves, and asbestos-packed cocks, which are illustrated and described.

INSTRUMENTS.—A recently issued bulletin of the General Electric Company (No. 4949) refers to direct-current portable instruments, designed for laboratory and general testing purposes. This line of instruments includes ammeters, voltmeters, milli-ammeters and milli-voltmeters.

TRANSFORMERS.—Descriptive Leaflet 2496 of the Westinghouse Electric Manufacturing Company describes out-door type, oil-insulated, self-cooling transformers of the same construction as those built for indoor service with the additional features necessary for installation out-doors.

ELECTRIC FURNACES.—Bulletin No. 10 of the Hoskins Manufacing Company, 453 Lawton Avenue, Detroit, Mich, deals with an electric muffle furnace for the efficient heat-treatment of tool steels, both carbon and high-speed. Information of the construction, operation and maintenance of these furnaces is given.

TRANSFORMERS.—The Moloney Electric Company, St. Louis, Mo., has published a handsome catalog on its high-efficiency transformers. The logical arrangement of the subject matter, the excellent cuts and diagrams and the clear, succinct manner of presentation combine to make this catalog of interest and value to the prospective purchaser. A table of resistance, reactance and impedance of circuits for different sizes of wire is included.

Business Notes

THE BOSCH MAGNETO COMPANY, New York, has offered a silver trophy to be presented to the most consistent performance in the amateur motorcycle championship races to be run at Columbus, Ohio, from July 17 to 21.

GODINEZ & MARSHALL.—Messrs. F. Laurent Godinez and Albert Jackson Marshall have opened an office at 123 Duncan Avenue, Jersey City, N. J., where they will conduct business as consulting lighting specialists. Both of these engineers have been prominently identified with the Illuminating Engineering Society. At its headquarters the firm will maintain a research laboratory and experimental station for allied public service corporations, formerly conducted by Mr. Godinez, who has acted in an advisory capacity for many large combination gas and electric properties.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 18, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,029,590. AUTOMATIC SWITCH; E. E. Clement, Washington, D. C. App. filed Oct 26, 1907. Telephone-exchange talking circuits.

1,029,591. ELECTRICAL SWITCHING APPARATUS FOR TELEPHONE SYSTEMS; E. E. Clement, Washington, D. C. App. filed Jan. 6, 1906. Design of an automatic switch-unit.

1,029,593. CONNECTING CIRCUIT FOR MAGNETO TELEPHONE-EXCHANGE SYSTEM; E. H. Colpitts, East Orange, N. J. App. filed Sept. 15, 1910. Common clear-out signal for a pair of connected subscribers.

1,029,640. ADJUSTABLE SUPPORT FOR TELEPHONE RECEIVERS; H. C. Schwager, Omaha, Neb. App. filed Dec. 16, 1911. For a desk stand.

1,029,649. AUTOMATIC RINGING SYSTEM; A. H. Wiess, Wilmette, Ill. App. filed Aug. 17, 1910. Intermittent telephone calling signal.

1,029,675. FLOOR TREAD; F. Erlach, Iron Mountain, Mich. App. filed March 23, 1912. Burglar-alarm device.

1,029,676. ELECTRICAL SWITCH; A. J. Gifford, Worcester, Mass. App. filed March 5, 1909. For double-circuit ignition systems.

1,029,698. ELECTRIC-RAILWAY SYSTEM; H. W. Leonard, Bronxville, N. Y. App. filed April 1, 1905. Combination of low-tension and high-tension service. (107 claims.)

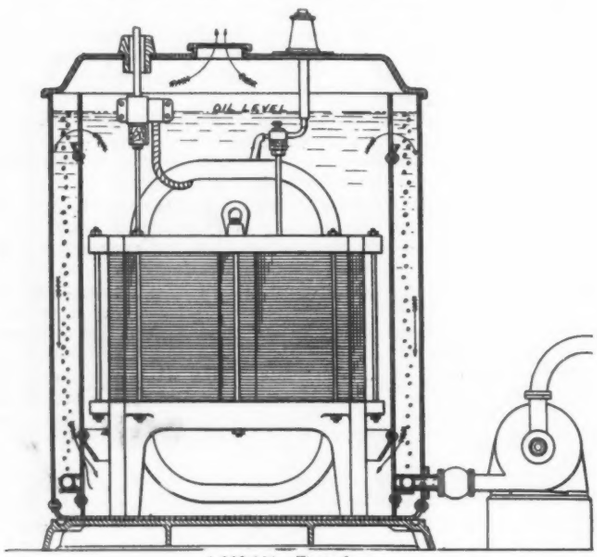
1,029,721. TERMINAL FASTENING; A. Schmidt, Flint, Mich. App. filed Nov. 27, 1911. Conductor clip for spark-plug, etc.

1,029,723. ELECTRIC CIGAR LIGHTER; D. E. Shea, Williamsport, Pa. App. filed Oct. 17, 1910. Ignition of burning fluid.

1,029,724. TELEPHONE REPEATER; F. J. Shubert, Portland, Ore. App. filed Jan. 27, 1911. Made reversible by artificial lines.

1,029,728. RAILWAY SIGNAL; J. D. Taylor, Edgewood Park, Pa. App. filed July 16, 1910. Electric-motor-driven semaphore.

1,029,743. METERING SYSTEM; F. Conrad and W. M. Bradshaw, Swissvale and Wilkinsburg, Pa. App. filed June 4, 1906. For measuring energy supplied from several sources.



1,030,091—Transformer.

1,029,750. ELECTRICAL PENDENT SWITCH: H. D. Gortner, Colorado Springs, Col. App. filed July 12, 1911. Two-part ball with transversely movable operator.

1,029,753. CIRCUIT INTERRUPTER; F. W. Harris, Wilkinsburg, Pa. App. filed Aug. 15, 1911. Auxiliary tripping device.

1,029,770. OPERATING DEVICE FOR STREET INDICATORS; P. T. Spindler, Chicago, Ill. App. filed July 3, 1911. Contact device on the trolley wire.

1,029,787. ELECTRIC ARC LAMP FOR SEARCHLIGHTS, PROJECTORS AND THE LIKE; H. Beck, Meiningen, Germany. App. filed Dec. 12, 1911. An indifferent gas protects a positive electrode.

1,029,811. SIGNALING APPARATUS; E. H. Long, Los Angeles, Cal. App. filed May 24, 1909. Fire-alarm service, etc. (Forty-three claims.)

1,029,850. X-RAY TUBE; E. W. Caldwell, New York, N. Y. App. filed March 13, 1909. For radiographic work.

1,029,851. INCANDESCENT MULTIPLE-CIRCUIT ELECTRIC LAMP; C. Carangelo, Delta Barrage, near Cairo, Egypt. App. filed Sept. 14, 1910. Support for metal filaments.

1,029,861. ELECTRICAL HAIR AND SCALP TREATING INSTRUMENT; H. C. Folger, Somerville, Mass. App. filed Sept. 29, 1910. For combing and drying the hair.

1,029,885. ELECTRODE FOR PRODUCING GAS REACTIONS BY MEANS OF THE ELECTRIC ARC; H. Pauling, Gelsenkirchen, Germany. App. filed Oct. 24, 1911. For producing nitric oxides, etc.; water-cooled.

1,029,886. ELECTRIC FURNACE FOR PRODUCING GAS REACTIONS; H. Pauling, Gelsenkirchen, Germany. App. filed Oct. 24, 1911. Water-cooled igniting electrodes and main electrodes.

1,029,956. SIGNAL BOX; N. H. Suren, Needham, Mass. App. filed July 22, 1910. Porcelain support for the contacts in fire-alarm boxes.

1,029,965. PROCESS OF ELECTROPLATING; J. W. Aylsworth, East Orange, N. J. App. filed Nov. 15, 1910. The article is burnished by pulp while plating.

1,029,974. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; G. A. Burnham, Saugus, Mass. App. filed Dec. 22, 1911. For furnishing incandescent-lamp service from an arc-lamp system.

1,029,975. REGULATOR FOR LIQUID BOILERS; A. Carpenter, Tacoma, Wash. App. filed Nov. 15, 1910. Automatic temperature regulator.

1,029,980. INSULATOR; J. Ellis, Salem, Mo. App. filed Dec. 23, 1911. Grooved block of insulating material.

1,030,013. DYNAMO-ELECTRIC MACHINE; H. H. Ralston, Norwood, Ohio. App. filed May 31, 1907. Locking commutator necks to the bars.

1,030,025. THERMOSTATIC DEVICE; T. H. Smith, Peekskill, N. Y. App. filed Sept. 9, 1910. Temperature alarm.

1,030,030. TIME-ELEMENT CIRCUIT-BREAKER; H. A. Steen, Milwaukee, Wis. App. filed Feb. 1, 1911. Electromagnetic.

1,030,036. SADIRON; A. H. and C. P. Waage, Chicago, Ill. App. filed July 28, 1911. Sectional heater.

1,030,037. AUTOMATIC RINGING SYSTEM; A. H. Weiss, Wilmette, Ill. App. filed Aug. 17, 1910. Telephone signal.

1,030,038. AUTOMATIC RINGING SYSTEM; A. H. Weiss, Wilmette, Ill. App. filed Aug. 17, 1910. Common-battery telephone; party line.

1,030,039. AUTOMATIC RINGING SYSTEM; A. H. Weiss, Wilmette, Wis. App. filed Aug. 17, 1910. Party-line telephone, etc.

1,030,040. SWITCHBOARD; W. F. Weyrauch, Chicago, Ill. App. filed Oct. 16, 1911. For taking up slack in the switch cords.

1,030,041. DYNAMO-ELECTRIC MACHINE; R. B. Williamson, Milwaukee, Wis. App. filed Nov. 20, 1909. Self-starting synchronous motor.

1,030,045. CONTACT DEVICE; E. L. Aiken, East Orange, N. J. App. filed July 16, 1904. Coin-controlled device.

1,030,050. SYSTEM OF CONTROL; L. E. Bogen, Milwaukee, Wis. App. filed April 19, 1909. Protective device operated by sympathetic vibrations.

1,030,053. PLATING MACHINE; S. C. Catlin, Bloomfield, N. J. App. filed Sept. 19, 1911. Rotating basket type.

1,030,060. AERIAL ELECTRIC LINE; W. Ellingen, Cologne-Lindenthal, Germany. App. filed March 9, 1912. Spaced, sagged wires.

1,030,061. DYNAMO-ELECTRIC MACHINE; B. Elshoff, Cincinnati, Ohio. App. filed Sept. 14, 1905. Commutator-bar fastening.

1,030,067. AUTOMATIC BURGLAR ALARM; W. W. Erwin, New York, N. Y. App. filed Nov. 26, 1909. Cord; circuit operation.

1,030,089. PARTY-LINE TELEPHONE SYSTEM; W. W. Hawkins, Cleveland, Ohio. App. filed May 10, 1906. Harmonic selection.

1,030,091. TRANSFORMER; J. L. Johnson, Milwaukee, Wis. App. filed Sept. 24, 1910. Oil-cooled and ventilated.

1,030,095. CORE STRUCTURE FOR DYNAMO-ELECTRIC MACHINES; E. R. Knight, Norwood, Ohio. App. filed June 7, 1909. Induction motor with reinforced core.

1,030,101. LAMP SOCKET; W. S. McLewee, Yardley, Pa. App. filed Oct. 28, 1910. Lamp sleeve, cap and switch-body.

1,030,102. ELECTRIC SWITCH; W. S. McLewee, Yardley, Pa. App. filed Oct. 28, 1910. Boxlike lamp socket.

1,030,103. TREATMENT OF BRINE; G. W. Malcolm and F. T. Munton, Davenham and Winsford, England. App. filed Oct. 26, 1908. Electrolytic removal of the calcium and magnesium salts.

1,030,124. STEERING-POST SWITCH; J. G. Perrin, Plattsburg, N. Y. App. filed Jan. 3, 1911. For automobiles, etc.

1,030,178. APPARATUS FOR THE ELECTRICAL PRODUCTION OF LIGHT; P. C. Hewitt, New York, N. Y. App. filed April 11, 1898. Mercury-vapor lamp.

1,030,181. AUTOMATIC SIDE-TRACKING SECTIONALIZER FOR ELECTRIC TRANSMISSION SYSTEMS; F. C. Hirdler, Oklahoma, Okla. App. filed Dec. 13, 1910.

1,030,185. ELECTRIC SWITCH; A. Jacobson, Lanesville, Mass. App. filed Dec. 4, 1911. Knife-blade switch for two sets of batteries.

1,030,195. MOTOR CONTROLLER; A. J. Loguin, West Allis, Wis. App. filed March 27, 1911. Protective device for induction potential starters.

1,030,196. BURGLAR ALARM; G. H. Lucier, St. Paul, Minn. App. filed June 2, 1911. Lock-bolt-operated.

1,030,197. SELECTIVE SIGNALING SYSTEM; J. McFell, Chicago, Ill. App. filed May 17, 1909. Interconnected single-wire common-battery system.

1,030,207. ELECTRIC SWITCH; J. J. Rawlings, Putney, London, England, and G. Sweetser, Upper Norwood, London, England. App. filed Feb. 25, 1911. Automatic bow-spring snapover.

1,030,240. MECHANISM FOR ELECTRICALLY TRANSMITTING AND REPRODUCING IMAGES; G. E. Hoglund, Chicago, Ill.. App. filed April 18, 1910. Silenium cells and synchronous shutters.

1,030,262. GAS OR VAPOR ELECTRIC APPARATUS; P. C. Hewitt and N. W. Rogers, New York and Mount Vernon, N. Y. App. filed March 23, 1901. Supplemental starting electrode. (Fifty-eight claims.)

1,030,265. PORTABLE CASH-BOX; J. Pallweber, Manheim, Germany. App. filed March 28, 1911. Alarm attachment.

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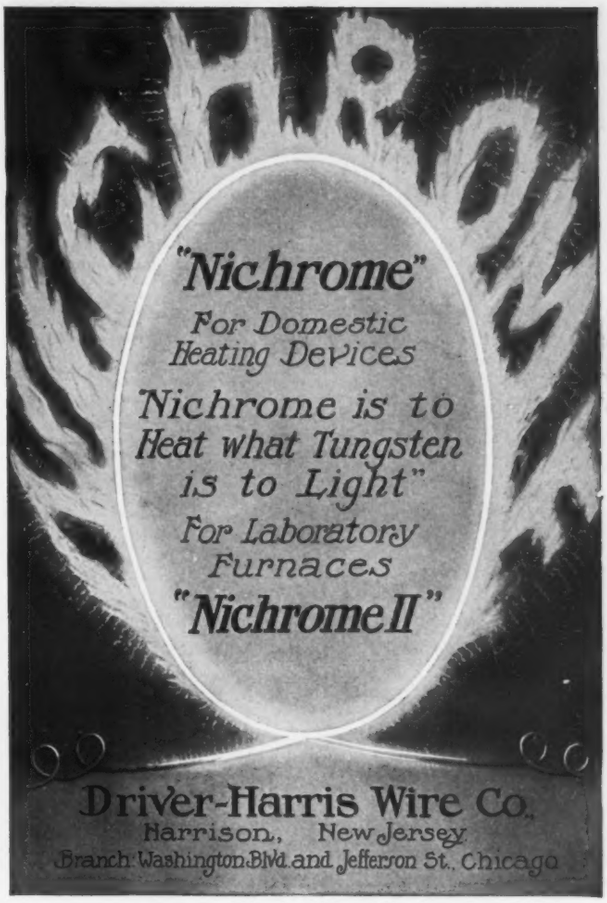
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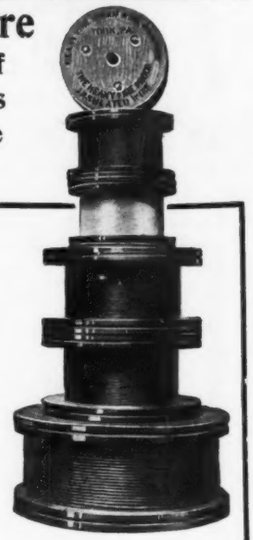

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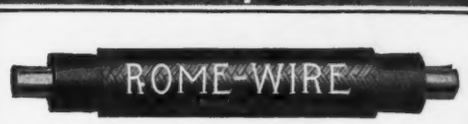

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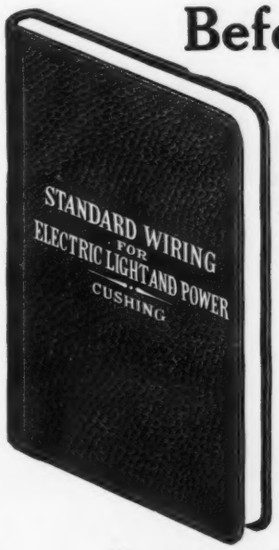

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Seattle, 4th Ave. South and Conn. St.
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BAKELITE

(Reg. U. S. Pat. Office)

The Synthetic Insulating Substance

Why use resinous compounds when Bakelite Impregnated Coils withstand a temperature of 500° F.

Withstands oils, steam, solvents and chemicals. High Dielectric Strength. Ask us about other applications.

GENERAL BAKELITE CO.

100 William St. New York

MITCHELL-RAND INSULATION

Red Sealing Cement

for

Sealing backs of switchboards, signs, panels, filling coil boxes, sealing joints in pipes, etc. Melts easily and flows freely. Made hard or soft as required.

Made in sticks, cakes, broken pieces or solid in barrel. Colors, black, brown, red or yellow.

This cement will harden quickly with a smooth glossy surface. Good adhesion and high insulating and waterproofing value.

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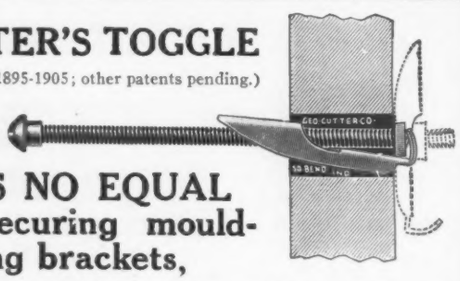
Electrical Insulating Materials of All Kinds

CUTTER'S TOGGLE

(Patented 1895-1905; other patents pending.)



HAS NO EQUAL for securing moulding brackets,

or any fixtures to walls and ceilings on which screws will not hold. It has no tiny rivet to limit its strength. Write for samples and price lists, stating fully your requirements.

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403 Notre Dame St. South Bend, Ind.

ORIGINAL VULCANIZED FIBRE

TUBES

Of **Special Quality** for Enclosed Fuses, Sleeves, Handles, Railroad and other Bushings, Ferrules, Socket Linings, Light Bearings, Electrical Conduit. **All standard sizes carried in stock. Colors: Red, Black and Gray.**

We manufacture the highest grade only. **Sheets, Rods, Washers, Discs, Cleats, Cord Adjusters and Special Shapes.**

Sheets in thicknesses up to 1½" **carried in stock.** Write for prices, samples and further information. 2

AMERICAN VULCANIZED FIBRE CO., Wilmington, Del.

"I am advised by Dr. ....., Professor of Chemistry of the ..... University, that you are putting out a Graphite Lubricating Preparation, which is the very finest thing of the kind he has ever seen."

This refers to

OILDAG

When Professors of Chemistry admit Oildag is a superior lubricant, it is time Power Station men realize its worth, particularly when Oildag is effecting a saving of approximately 60% in cylinder oil in one station.

ARE YOU ALERT TO YOUR POSSIBILITIES

You must be interested. Send for Booklet 416 F.

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General Agents for Oildag, made by Acheson Oildag Company. 4

Can't Separate in the Conduit
COPE CONDUIT RODS

T. J. COPE, 3244 N. 15th St. Philadelphia

Ask for the details of Cope Cable Rack and Conduit Threading Machine.

W. R. Ostrander & Co.

Manufacturers

Electric Bells — Speaking Tubes, etc.

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Carrying 30 feet 3″ Socket Joint.

Orangeburg Fibre Conduit

(" Admitted to be the best Fibre Conduit.")

Made with four styles of joints: Socket, sleeve, screw and "Harrington," with bends and fittings for same.

Is the Lightest Conduit Made

(3″ socket joint 1.2 lbs. per foot.)

hence the freight and cartage charges are reduced to the minimum.

Send for The Conduit Book.

The Fibre Conduit Company

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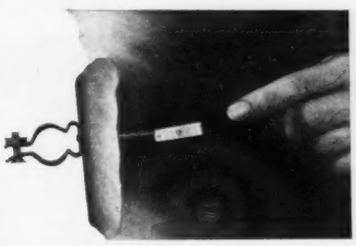
This Simple Device Will Save You Money Time and Trouble



The "Ajax" Toggle Bolt goes through the plaster like this

It requires but a ew moment's time to attach any object to plaster wall, ceiling or any form of hollow partition when the Ajax Toggle Bolt is used. And the job is much neater and far more secure than when screws are used.

Try a ew Ajax Toggles on your work in hand and see how you like them. Made in various styles and sizes. Bulletin and prices on request.

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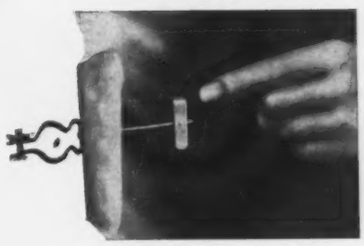

The "Ajax" Toggle Bolt then assumes this position

3

HEMMING INSULATION
GUMMON
(EG)
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THE STANDARD HEAT RESISTING MOLDED INSULATION.

THE KIND TO SPECIFY AND OBTAIN

UNIFORM RESULTS

HEMMING MANUFACTURING CO.
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THERE IS A DIFFERENCE

Did you ever stop to consider that there is a difference in Soldering Flux? There is—much more than you might think. You can buy good or poor grades of all kinds of products, so can you buy both good and inferior grades of Soldering Flux.

We use the highest grade of raw materials, thoroughly tested by expert chemists, who have had years of experience, with a result that is gratifying to the consumer. This fact is evident when we say that we have customers who are the largest Dynamo and Motor builders, as well as manufacturers of the most delicate measuring instruments that have been using our brand of Flux for many years and would not use any other under any consideration. They tell us so.

Send for samples and prices. For sale by all Jobbers.

L. F. Neer Company
Successors to Ever Ready Co.
Stock carried at—50 Church St., N.Y. —Butler, Ohio—763 Market St., San Francisco, Cal.

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REG. U. S. PAT. OFF.

MAKES EASY

FISHING

Duraduct is indestructible not affected by Heat or Cold.

Twist it, tie in a knot, crush it with your foot or anything you like to flatten it and a few moments' manipulation with the hand on the outside of the conduit and it will regain its original shape.

You should find out all about this *new* conduit.

Tubular Woven Fabric Co.
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TRADE **BX** MARK

TRADE **BX** MARK **FLEXIBLE STEEL ARMORED CABLE** TRADE **BX** MARK

SAVES TIME
AND
INSURES SATISFACTION
AND
SERVICE VALUE

Twin Conductors Type "BX."

Why injure trim and decorations when the flexibility of BX Cable is such that it can be easily fished and drawn into floors and walls, bent over beams and around corners? It possesses great mechanical strength and eliminates all danger from chafing and crossed wires. Approved by Underwriters' Laboratories, Inc. **Ask for Catalog No. 4363**

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ELECTRIC WORKS
Of General Electric Company

Main Offices: 527-531 West 34th St., New York, N. Y.

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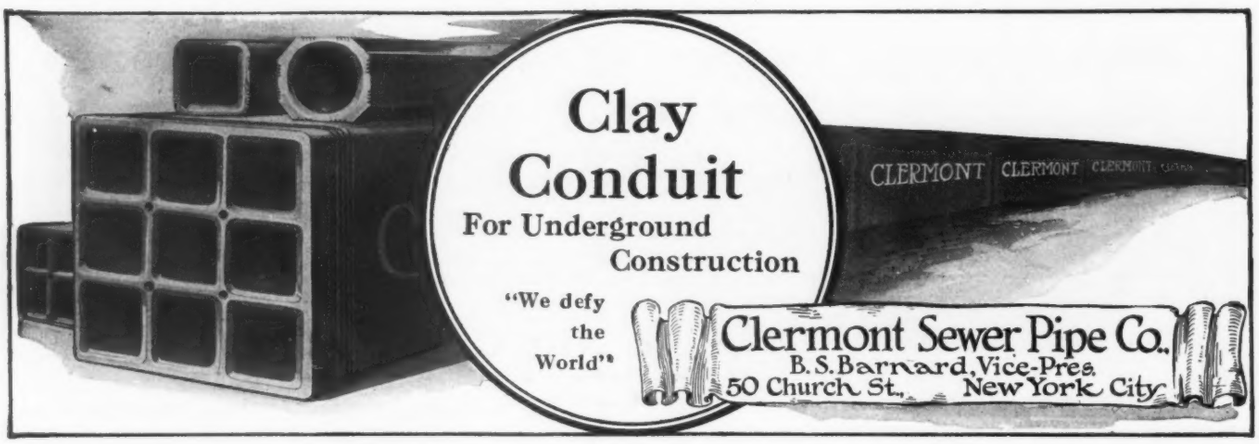


Clay Conduit
For Underground Construction

"We defy the World"

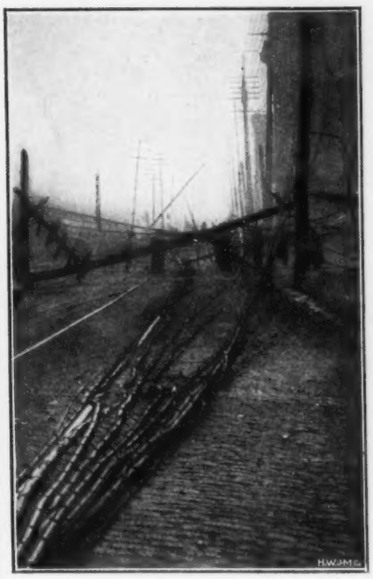
Clermont Sewer Pipe Co.
B. S. Barnard, Vice-Pres.
50 Church St., New York City

"To keep posted,

so that whatever was installed might represent the most advanced stage of the electrical art, was one of our first undertakings," said Mr Edward D. Adams in referring to the original development of electricity at Niagara Falls. One of the ways in which this was done was to make clippings from the leading technical journals of the world.

The Electrical World,

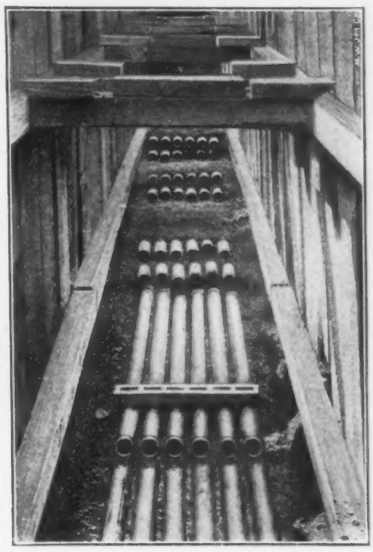
in addition to its own unrivaled news service and the technical matter prepared by its staff of editors and contributors, digests seventy foreign periodicals. The World in this way affords the only means of keeping fully abreast of every development in the electrical field that is of professional or commerical value to members of the industry.



Result of Wind and Sleet Storm

Put Your Wires Underground in J-M Fibre Conduit

"The Strongest Conduit Made"



Typical Installation of J-M Fibre Conduit

Pole lines are an extravagance. Continuous service is possible only when you have a permanent reliable installation.

The following advantages should be noted:—

1. Repair costs are eliminated—depreciation nil.

2. J-M Fibre Conduit affords greatest protection to cables, being an absolutely water-proof, non-corrosive, permanent insulation and having great dielectric and mechanical strength.

3. Service tests show that J-M Fibre Conduit lasts indefinitely.

4. Material similarly treated is in good condition after forty years of service underground.

5. The impregnating compound used affords absolute protection from decay.

Furnished with Bell or Straight Joints in four styles: Socket, Drive, Sleeve and Screw, with fittings to meet all conditions. Standard 2-in. to 4-in. diameter, Bell Joint 54-in., Straight Joint 60-in. long. *Quick Shipments.*

Write nearest house for full particulars.

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MANUFACTURERS OF ASBESTOS AND MAGNESIA PRODUCTS — ASBESTOS — ASBESTOS ROOFINGS, PACKINGS, ELECTRICAL SUPPLIES, ETC.

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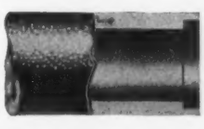

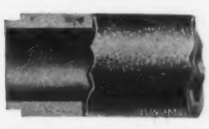

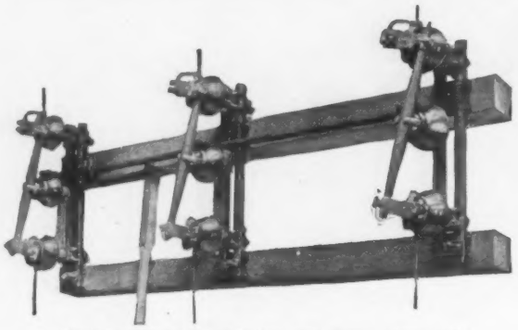

Combined Poletop Switches and Fuse, Type 500.
Patented April 12, 1912.

Home-Made Switches Prove One Thing

That there is a distinct demand for the right kind of Poletop Switch. Some of these home-made switches are very good. Most of them are—not. But there is no further need for them, because

Pacific Poletop Switches

exactly meet existing conditions. They meet the demand for "Quick, Easy and Cheap" installation and operation. Every condition that arises or is likely to arise in the distribution of high potentials has been considered and provided for or against. If you are responsible for continuous operation of a transmission line, you are missing the sense of security that comes with the installation of Pacific Switches.

Better investigate at once. Let us mail you interesting printed matter.

Pacific Electric Mfg. Co.
San Francisco, Cal.

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LAVITE

can be machined as easily as brass

It stands any heat, and can be furnished in any form that can be produced by machine tools.

In dielectric strength it is second only to glass, and its compressive strength is more than twice that of granite.

Write for sample, and test it—you will be convinced that "there's nothing so good as Lavite."

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STOP!—

YOUR GROUNDING TROUBLES

You can do it easily and save time and money. How? Just by doing what most all progressive companies are doing

INSTALL PARAGON GROUND CONES

They pay for themselves in a short time by saving all up-keep expense. How soon are you going to try them? Better do it now.

The Paragon is made of pure perforated copper, conical shape. To install drop cone in post hole—that's all. Absolutely dependable.

Made in 12 and 24-inch lengths and of 25 and 21 gauge copper.

Your jobber can supply you. If not order of us. Write for FREE grounding Booklet.

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Screw Machine Products

Up to $\frac{7}{8}$ inch diameter, made to order from steel or brass. Let us figure on your requirements for special binding posts, screws, studs, etc. We guarantee our work to be accurate.

The Wallace Barnes Co.
Bristol, Conn.

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SPRINGS Good Ones

You can rely upon them—we watch the material, the work—and test the product. We make all kinds of good Springs.

See our Booklet.

Cary Spring Works
240-242 W. 29th St.
NEW YORK

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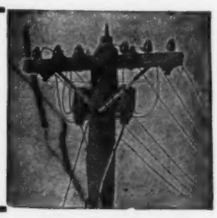
Ultimate Economy
under actual service conditions has been proven by
COLONIAL POT HEADS
All porcelain, two-piece, brown glaze, with insulating compound that positively cannot leak in service up to 6600 volts, tested to 30,000. Let us send you full details of the cheapest and best pot head made.
Colonial Sign and Insulator Company, Akron, Ohio



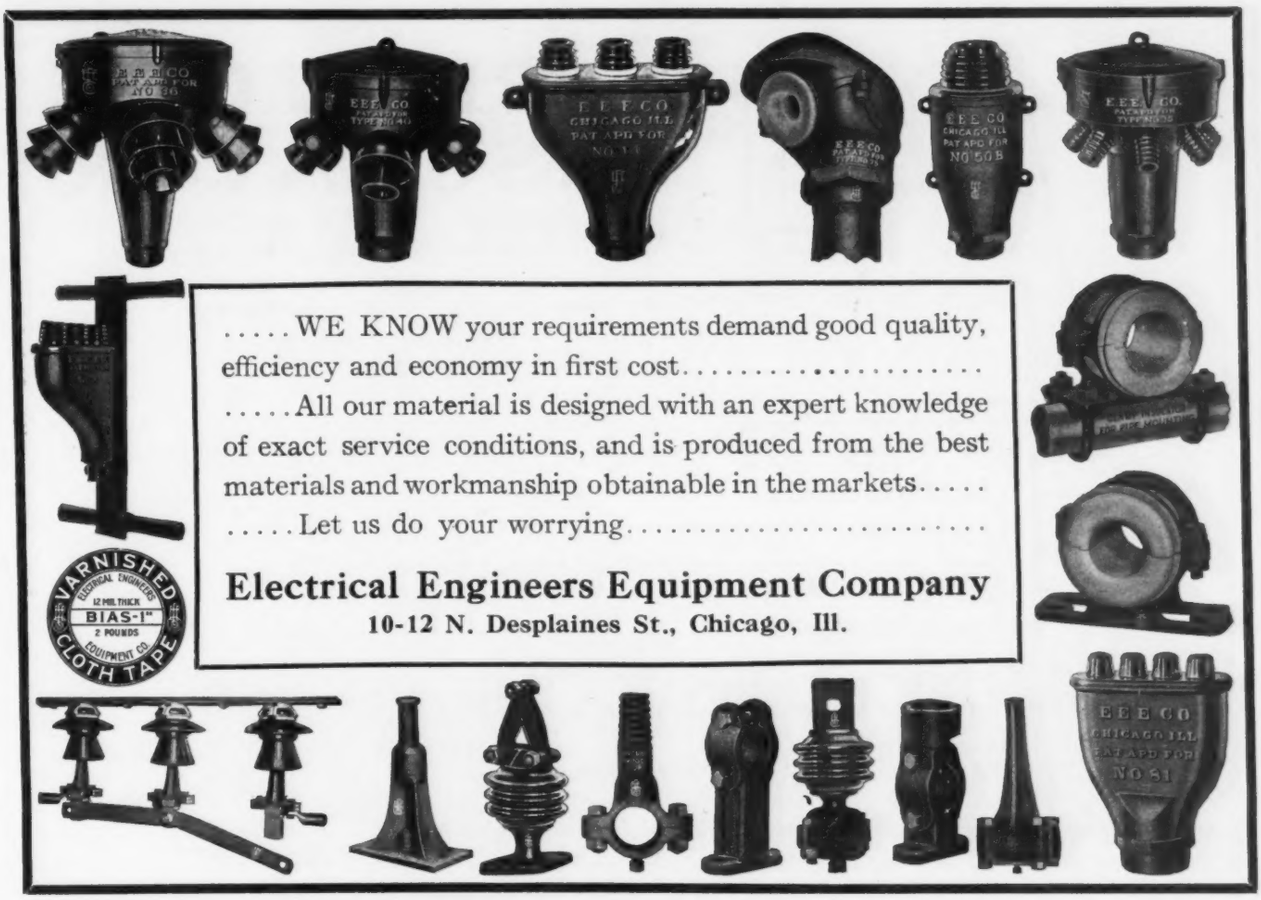
DO YOUR POLES DECAY?

Then reinforce them with the

ORR REINFORCEMENT

You double their life at two-thirds the cost of setting new poles. Write for Booklet.

PITTSBURGH REINFORCING POLE CO.
435 6th Avenue **Pittsburgh, Pa.**



.....WE KNOW your requirements demand good quality, efficiency and economy in first cost.....
.....All our material is designed with an expert knowledge of exact service conditions, and is produced from the best materials and workmanship obtainable in the markets.....
.....Let us do your worrying.....

Electrical Engineers Equipment Company
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VARNISHED CLOTH TAPE — ELECTRICAL ENGINEERS EQUIPMENT CO. — 12 MIL THICK — BIAS-1" — 2 POUNDS

"THESCO"
Vertical Wire Clamps

will fasten any conductor, up to 1¼" diameter, to any ordinary sized insulator. And they won't break the insulators either—the single bolt takes care of that.

Write for particulars and prices.

The States Company
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1

You Can Always Be Sure of the Best

IF YOU WILL ALWAYS SPECIFY

Dunbar Springs

Small Springs made from sheet steel or steel and brass wire

THE DUNBAR BROTHERS COMPANY
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1

Manufacturers of HARD and FLEXIBLE FIBRE

DIAMOND STATE FIBRE COMPANY
ELSMERE U.S.A. DELAWARE

For ELECTRICAL INSULATION and MECHANICAL PURPOSES

Made in SHEETS, RODS, TUBES, WASHERS, DISCS and SPECIAL SHAPES

COLORS: RED, GREY and BLACK. Write for Estimates

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Manufacturers of High-grade Single and Multiple Vitrified Salt Glazed Clay Conduits.

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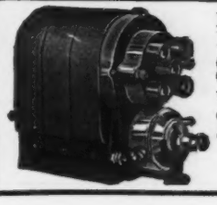
The Monitor System of Automatic Control for Electric Motor Drive.
Start—Stop—Reverse—Accelerate—Retard



Nothing could more clearly show the Perfect Ignition always given by the
SPLITDORF MAGNETO
than the constant victories of **Splitdorf** equipped cars in all parts of the country. Ask for Magneto catalog.

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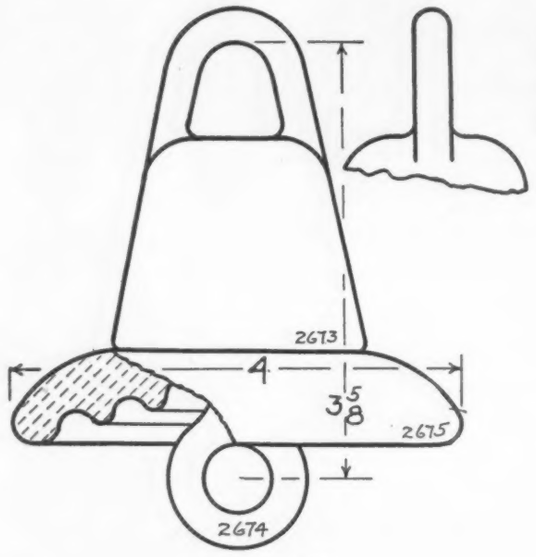

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A REAL GUY INSULATOR

This insulator is designed to be used for guy and similar purposes and entirely supersedes globe composition insulators.

It is absolutely permanent against all weathering; it affords decidedly greater insulation with protected surfaces; it has an ultimate strength of 4000 lbs. and upward.

It may be used up to 6600 volts; is tested at 30,000 volts; has rain test of 16,000 volts and leakage surface of 3¼ inches.

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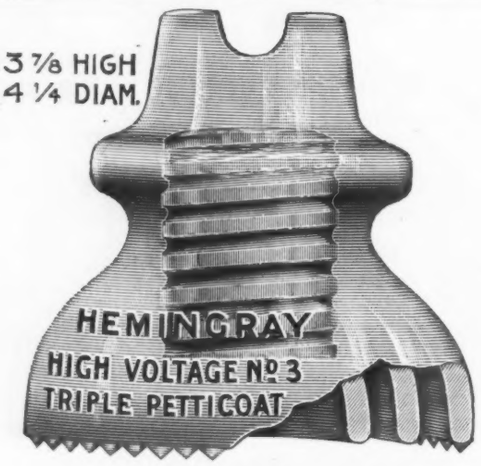

See the teats on the petticoat

THE WORLD'S STANDARD

Hemingray Insulators have been on the market for many years—they're kept in the van of improvement. Our high voltage types with patent drip petticoats are particularly worthy of notice. All in catalog—get it.

HEMINGRAY GLASS CO.,
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Hard Porcelain
For Electrical Specialties
IMPERIAL PORCELAIN WORKS
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THE STAR PORCELAIN COMPANY
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Send for printed matter on Insulating Joints, Dim-a-lites, Resistance Units.

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AUTOMATIC MOTOR STARTERS, LIFTING MAGNETS, CONTROLLERS, ETC.
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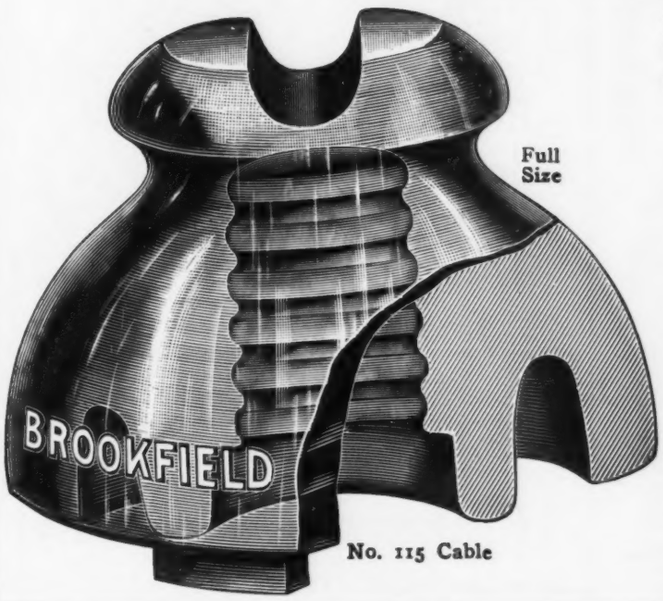
BROOKFIELD
STANDARD INSULATORS



Full Size

No. 115 Cable

Mechanical Strength, Uniformity and Electrical Efficiency are features of our insulators.

Careful packing and prompt shipment from a large stock.

47 Years of Experience.

Over 200 Designs.

High Voltage Insulators.
Low Voltage Insulators.
Battery Supports.
Bushings.
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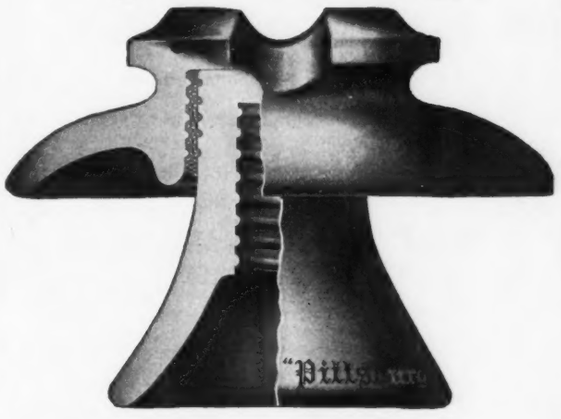
"Pittsburg"



INSULATORS

have had a very noticeable effect in freeing many high-tension transmission lines from breakdown and costly replacements and interruptions to service.

They are designed and made to give high service efficiency under severe conditions. For all voltages from 4000 to 200,000.

Write for Catalog No. 2.

The Pittsburg High Voltage Insulator Co.

Main Office and Factory: DERRY, PA.
New York Office: 114 LIBERTY ST.
St. Louis Office: 301 S. 7th ST.

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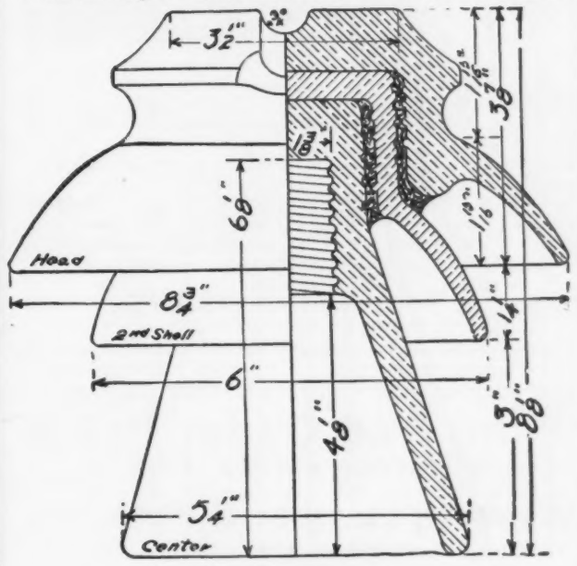
Thomas Insulator No. 3026



Line Voltage 33,000
Dry Test Voltage 90,000
Rain Test Voltage 65,000

The R. Thomas & Sons Co.

Established 1873 Incorporated 1892
Main Office, EAST LIVERPOOL, O.

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11

G & W ELECTRIC SPECIALTIES

G & W ELECTRIC SPECIALTIES

The G & W Electric Specialty Company brought out the first successful outside Pot Head eight years ago. The line has since been broadened and developed in response to the demands of modern practice until today it meets any requirement of modern Central Station Equipment.

POT HEADS

DETACHABLE - NON-DETACHABLE
COMBINATION
ALL VOLTAGES

The line comprises: **Subway Junction Boxes, Series Switches, Primary Cut-Outs, Ground-Pipe Caps, Voltage Detectors, Compound, etc.**

Any pole or line can be made a switching and testing point at small cost through the use of G & W Devices. Many installations in all parts of the country in use for over six years.

G & W Electric Specialty Co.
6408 Jackson Park Ave.
CHICAGO, ILL., U. S. A.

Send for Catalog No. 7

Don't Blame Your Insulators When They Go "Pop"

Such breakage is due to a perfectly natural cause—the sun's heat expands the glass, the pressure exceeds the strength of the material and there's another job for the "trouble shooter." Stop the trouble by using the

Peirce Spiral Spring Thread

When heated, it simply elongates and creeps further up in the insulator thread, preventing destructive pressure on the glass. When it contracts, it still keeps closely in contact—insulators don't wobble.

It's resilient, too—helps absorb sudden jerks and strains on the wires.

Remember that the hardware *makes* the line and Hubbard makes *the* hardware.

Write to-day for bulletins describing Hubbard Modern Line Hardware and Peirce Specialties.

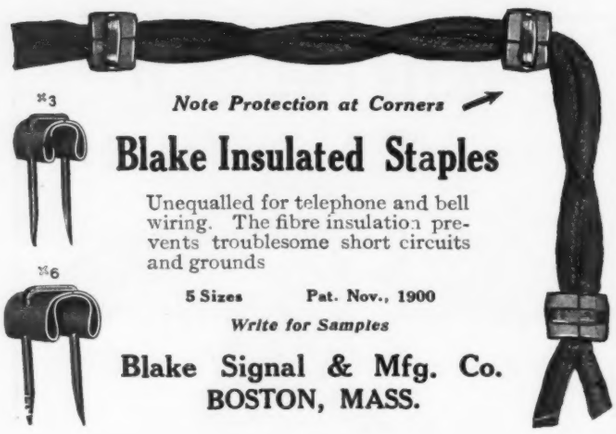
Hubbard and Company
Pittsburgh

"THE FUSE YOU WILL USE"

Daum Patent

DAUM'S REFILLABLE CARTRIDGE FUSE SHELLS for Electric Light and Power Circuits. 250 to 2500 Volts.
Adopted as STANDARDS by some of the largest Corporations in United States and Canada.
SAVES MONEY—TIME—and TROUBLE. Easy to REFILL with Fuse Wire as often as they blow out. LAST FOR YEARS. Trial orders sent on Approval to responsible parties; send for sample today.

A. F. DAUM COMPANY
PITTSBURGH, PENN.



Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds

5 Sizes **Pat. Nov., 1900**

Write for Samples

Blake Signal & Mfg. Co.
BOSTON, MASS.

Idaho Red Cedar Poles

24 Cedar Yards—Idaho, Wash., & R. C.

Western Lumber & Pole Co.
Main Office: Electric Bldg., Denver, Colo.

WASHINGTON FIR
Cross Arms
A Large Pittsburgh Stock
UNION ELECTRIC CO., Pittsburgh, Penna.

POLES Idaho Red Cedar Resident Producers

Sandpoint Lumber & Pole Co. Ltd.
SANDPOINT, IDAHO

Send Us Your Catalog

Keep us posted as to your progress. Our catalog file is consulted by hundreds of visitors to New York.

"I Wish I Had A Dollar

for every K.W. of transformer capacity on our lines" was the idle remark we once heard made by a Central Station manager. If the transformers had been

MOLONEY Transformers

he might really have had at least a dollar each year for each K. W. of transformers installed—that is about what Moloney transformers save in core and copper loss over the ordinary kind.

A word to your stenographer will bring proof of all our claims.

MOLONEY ELECTRIC COMPANY

Windsor, Ont. Canada — **Office and Works** — **St. Louis, U. S. A.**

Agents and Local Stock:
Doubleday-Hill Electric Company, Pittsburg, Pa.
Doubleday-Hill Electric Company, Charlotte, N. C.
Davies, M. C., Tacoma, Wash.
Fobes Supply Company, Seattle, Wash.
San Francisco, Cal., Office, Rialto Building.
Fobes Supply Company, Portland, Ore.
Nixon-Kimmel, Spokane, Wash.
Roberts Electric Supply Company, Philadelphia, Pa.
Roberts Electric Supply Company, Syracuse, N. Y.
Chicago, Ill., Office, 526 McCormick Building.

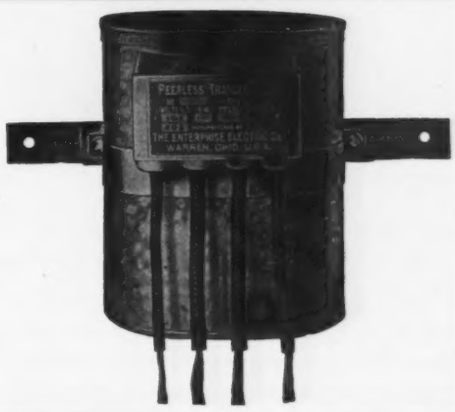
Consider the Difference

in the cost of operating carbon and Mazda lamps—and then consider the savings that

Peerless Sign Lighting Transformers

will effect for you. Get our data, and you can make more profit on your sign lighting business.

The Enterprise Electric Co., Warren, Ohio



AGENTS

National Elec. Supply Co., Washington, D. C.
Northwestern Elec. Equip Co., St. Paul, Minn.
Erner Electric Co., Cleveland, Ohio.
J. G. Schaff Electric Co., of Chambersburg, Pa., and Hagerstown, Md.
Maydwell Co., San Francisco, Cal.
Illinois Elec. Co., Chicago, Ill.
John McC. Price Co., Pittsburg, Pa.
J. C. McClure & Co., Portland, Ore.
John A. Savage & Co., Denver, Colo.

Packard

TRANSFORMERS

are sold on a decidely favorable *free-trial* basis and a yearly contract proposition. Send for the Packard Literature today.

THE PACKARD ELECTRIC CO., 312 Dana Avenue Warren, Ohio

WE MAKE

SIGN RECEPTACLES

No. 61988

in 6 different styles: for Wooden Signs and for Metal Signs; in one piece or two pieces; those held to the sign by screws or by a screw-ring.

They are all made in the Paiste way which means utmost care in every part.

Our catalog shows them all and a free sample will be gladly sent for your inspection if you are interested.

H. T. PAISTE CO., Philadelphia Pa.
New York Boston Chicago 11

USL

TRADE MARK

THE UNITED STATES LIGHT AND HEATING CO.

(Formerly National)

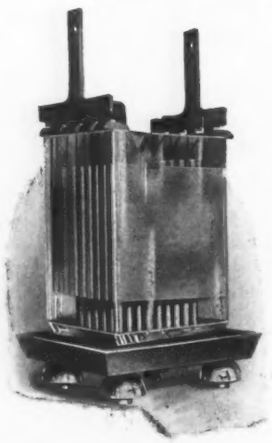
Storage Battery

stands for

Efficiency

and

Durability



No matter what the service requirements are, the **U-S-L** is a good buy.

A long battery building experience, exceptional facilities and thoroughness in manufacture contribute to make this a high grade battery.

WRITE FOR INFORMATION

The United States Light & Heating Company

General Offices:
30 Church Street, New York

Factory:
Niagara Falls, N. Y.

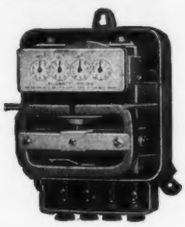
Sales Offices and Depots:
New York Buffalo Detroit St. Louis
Boston Cleveland Chicago

DUNCAN

Direct Current Watthour Meters

DUNCAN

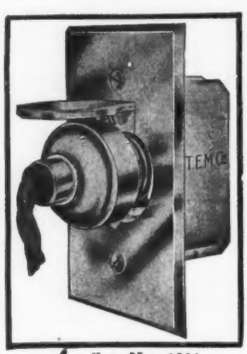
Alternating Current Watthour Meters



DUNCAN

Transformers
FOR ALL PURPOSES

Duncan Elec. Mfg. Company
LA FAYETTE, IND.



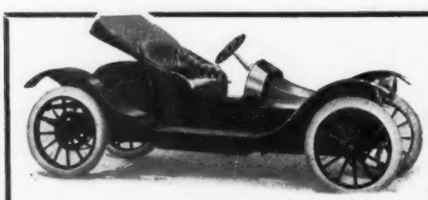
Cat. No. 1001

FLUSH RECEPTACLES

We are making a special drive on this line. Get next!

All finishes.

THE TRUMBULL ELECTRIC MFG. CO., Plainville, Conn.
N. Y. BOSTON CHICAGO PHILADELPHIA SAN FRANCISCO



See Convention Number Page 323

S. R. Bailey & Co.
Incorporated
895 Boylston St., Boston
Factory, Amesbury, Mass.

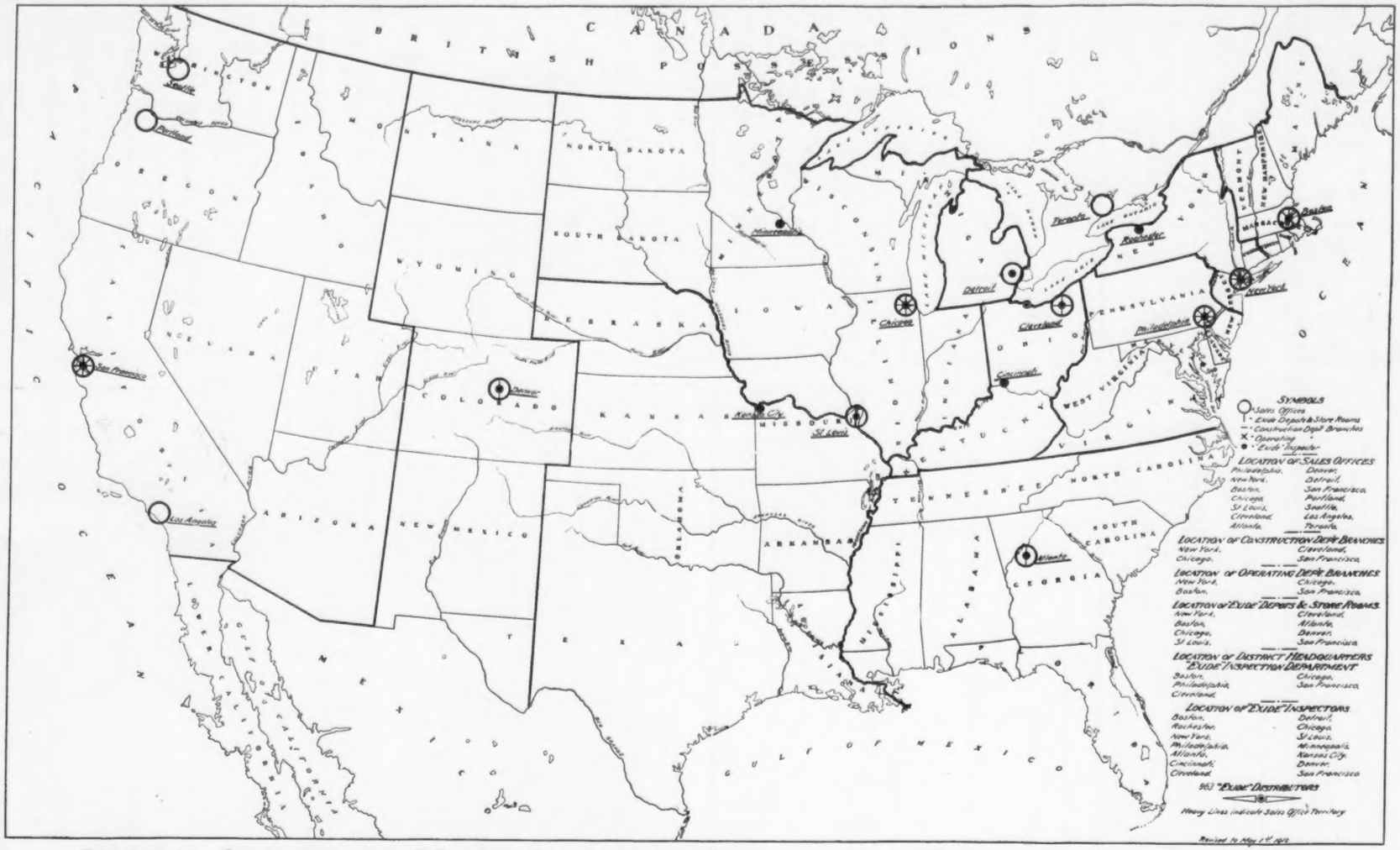
The J & J "Multiple Control Switch"

Pays for itself in 5 weeks, guaranteed for 5 years. Not a time switch—operates from power plant. Send for details of our 30 NIGHTS' FREE TRIAL.

The J. & J. Electric Company
1303 Central Bank Bldg., - - Memphis, Tenn.

The "Exide" Batteries for Electric Vehicles

THE SERVICE ORGANIZATION OF THE ELECTRIC STORAGE BATTERY CO.



GENERAL OFFICES AND WORKS ALLEGHENY-AVENUE AND 10TH-STREET, PHILADELPHIA.

The Edison Storage Battery

"Built Like a Watch and as Rugged as a Battleship."

Edison Storage Battery Company
145 Lakeside Avenue
Orange, N. J.

A Satisfied User.

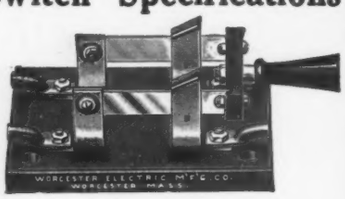
The Guarantee Protects You

Manhattan Electrical Supply Co.
New York Chicago
St. Louis

Write "Worcester"
Into Your Switch Specifications

If you want the most carefully built reliable switches on the market.

The Worcester Catalog describes all types and sizes, besides our Switchboards and Panelboards. Write for it to-day.



Worcester Electric Mfg. Co.
44 Lagrange Street, Worcester, Mass.

KENT POCKET METERS
STANDARD BATTERY TESTERS
ACCURATE, HAND GRADUATED, CLEARLY READ SCALES, WITH UNBREAKABLE WINDOWS

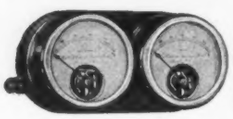
Combination Volt-Ammeters

0-6 V. 0-30 Amps.	$6.00
0-10 V. 0-30 Amps.	7.00
Voltmeters 0-9 V.	4.00
Ammeters 0-30 Amps.	4.00

Atwater Kent Mfg. Works
46 N. Sixth St. Philadelphia

Accurate, Compact, Inexpensive
VOLTMETERS, AMMETERS and VOLT-AMMETERS
Send for complete catalog

LOUIS M. PIGNOLET
78 Cortlandt Street New York



A distinguishing, we might almost say exclusive, feature of the

HOYT
Line of
Ammeters and Voltmeters

is their extreme flexibility, adapting them to practically every use required in modern practice.
Ask for Bulletin E.W.

Hoyt Electrical Instrument Works
Penacook, N. H.
Sales Offices:
161 Summer Street, Boston, Mass. 136 Liberty Street, New York.
80 Michigan Avenue, Chicago, Ill.

MARCONI
CONDENSERS
Variable condensers. Fixed condensers of all capacities and dielectric strengths.
Experimental and Commercial Wireless Telegraph Apparatus.

Marconi Wireless Telegraph Co., of America
Dept. W. 29 CLIFF STREET, NEW YORK

Battery Testing Instruments
that are well made and accurately calibrated. Watch type—light weight. In leather case for carrying.

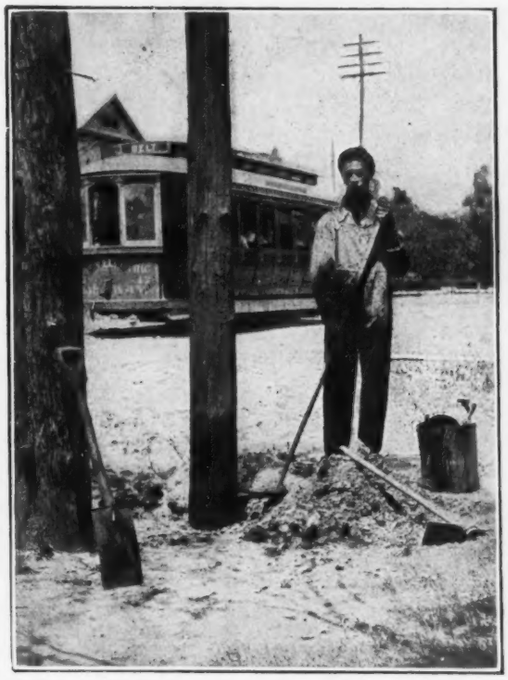
ELDREDGE ELECTRIC MFG. CO. 3
103 Post Office Square Springfield, Mass.

GOULD STORAGE BATTERIES
For central station service, propelling street cars, electric vehicles, low voltage lighting systems, etc. WRITE FOR LITERATURE.

Gould Storage Battery Co.
MAIN OFFICES:—241-7 Fifth Avenue, New York Works:—Depew, N.Y.
BRANCH OFFICES:—San Francisco, Chicago, Boston, Cleveland
AGENTS:—Detroit, Topeka, Los Angeles, Seattle.

WILLARD STORAGE BATTERIES
FOR ALL PURPOSES
Manufactured by
The Willard Storage Battery Co.
Cleveland, Ohio

You Can Save Ninety Dollars a Mile or More In Maintenance of Your Poles Now Standing



Method of Applying "C-A-Wood-Preserver" to standing poles

MEMPHIS TELEPHONE CO.
Office of GENERAL MANAGER
196-198 Monroe Street

Memphis, Tenn. June 24th-07.

C. A. Mfg. Co.,
Austin, Texas.

Gentlemen:

During the summer of 1904, we treated about 2000 cypress poles with one coat of C. A. Wood Preserver, in the following manner: The earth was removed from around each pole about eighteen inches deep, and after allowing the pole to dry out a day, a coat of hot C. A. Wood Preserver was applied to each pole to the depth the earth had been removed and up about two feet above the ground. A recent examination of some of the poles shows the decay that occurs at or near the surface of the ground was arrested when the application was made, and the poles give every evidence of lasting eight or ten years longer.

The writer has during the past fifteen years used the C. A. Wood Preserver, and has had excellent results from its use. On poles and cross arms when properly applied, their life is more than doubled.

Yours very truly,

General Manager.

Here is one piece of proof—others on request

As almost every observer knows, poles are attacked by rot at and below the wind and water line, where moisture is most persistently in contact with the pole.

It is a very simple matter, as the illustration and letter show, to get at this portion of the pole.

If you have poles standing which are beginning to show signs of decay you can stop the rotting and prolong the life of poles indefinitely by a single application of

"C-A-WOOD-PRESERVER"

as shown and described in the illustration and letter.

The entire process, including all labor and material, will not cost you at the very most more than

THIRTY CENTS PER POLE

As a matter of fact, that is probably an excessive figure. It is much more apt to be nearer twenty cents per pole than thirty.

Accepting the figure of thirty cents, however, and figuring only thirty poles to a mile of line at a valuation of only $3.00 per pole, you would be spending only

NINE DOLLARS PER MILE TO SAVE NINETY

And the use of "C.-A.-Wood-Preserver" in this manner will at least *double* the life of your poles.

If you are interested in such savings of maintenance charges we shall be glad to give you further information—and proof if you want it. "C.-A.-Wood-Preserver" is as valuable for preserving cross-arms or exposed timbers used for any purpose as it is for poles.

C-A-Wood-Preserver Co.

ST. LOUIS, MO.

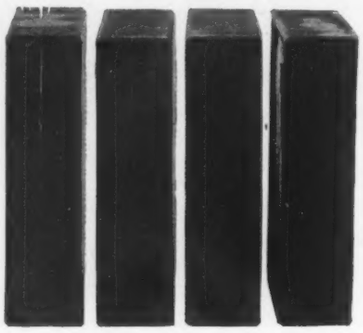
CHICAGO AUSTIN, TEXAS NEW YORK INDIANAPOLIS NEW ORLEANS
SALT LAKE CITY—Western Elec. Co. DENVER—Western Elec. Co.

TRADE MARK C-A WOOD PRESERVER REGISTERED U.S. PATENT OFFICE

Western Electric Company, Pacific Coast Selling Agents

SAN FRANCISCO LOS ANGELES PORTLAND SEATTLE

TRADE MARK C-A WOOD PRESERVER REGISTERED U.S. PATENT OFFICE



Over 31,000 Miles with less than 3/16 Inch Brush Wear

These are the brush faces after the car ran 31,000 miles. The photograph was not retouched. This is the way the brushes looked.

No burning. No pitting. No chipped edges.

No roughened commutator. The highly polished brushes could not wear away the copper.

LACLEDE CUTS OPERATING COST.

National Carbon Co.

Cleveland
Sixth City

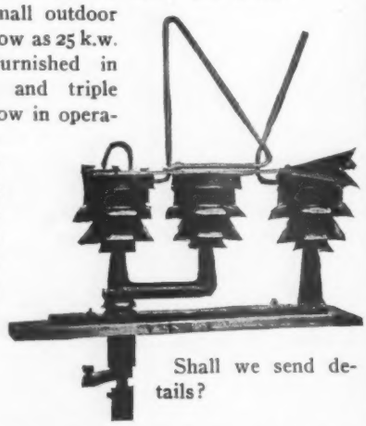
There Are Numberless Opportunities

for taking on profitable load along your transmission line. You can take advantage of them if you use

Burke Horn Type Switches

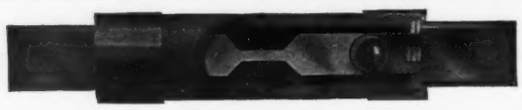
Fuses and Horn Gap Arresters. They will make it possible for you to safely and profitably operate small outdoor substations as low as 25 k.w.

They are furnished in single, double and triple pole, and are now in operation on all voltages up to 66,000. Invaluable as disconnecting switches for the protection of *any* substation.



Shall we send details?

Railway & Industrial Engineering Co.
PITTSBURGH, PA.

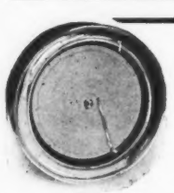


Save 75%
of your annual fuse expense by using
ECONOMY RENEWABLE CARTRIDGE FUSES

Can be easily and cheaply renewed without returning to the factory, no soldered connections. Guaranteed to operate the same as standard non-renewable fuses. Beware of crude imitations.

ECONOMY FUSE & MANUFACTURING CO.
(INCORPORATED)
Orleans and Kinzie Sts. Chicago

Sales Offices:
New York Pittsburgh Cleveland Denver Detroit
Philadelphia Cincinnati Chicago Birmingham Kansas City
The Madywell Company, Pacific Coast Distributors.
Seattle, San Francisco and Los Angeles
(Licensed Under Mallory Patents.)



Recording Gauges

"INDUSTRIAL"
Indicating and Recording
Gauges—Thermometers—Tachometers—Pyrometers

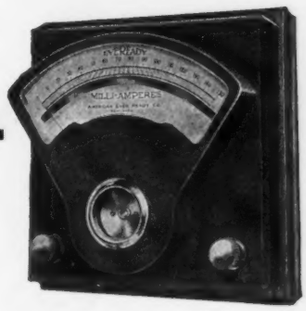
STAND THE TEST OF SERVICE
Write for Bulletin No. 65

The Industrial Instrument Co.
New York Foxboro, Mass. Chicago

Anderson Switches and Switching Devices

for Central Stations

Albert & J. M. Anderson Mfg. Co.
289-293 A STREET BOSTON, MASS.



Carry It With You

Here is a meter you need have no fear of being too delicate for practical work. It is sensitive and accurate ***without being delicate.*** This is accomplished by the construction. Many of the exceedingly fine adjustments and narrow clearances have been made unnecessary for the simple design. The Eveready Meter embodies the d'Arsonval principle worked out in the most direct way.

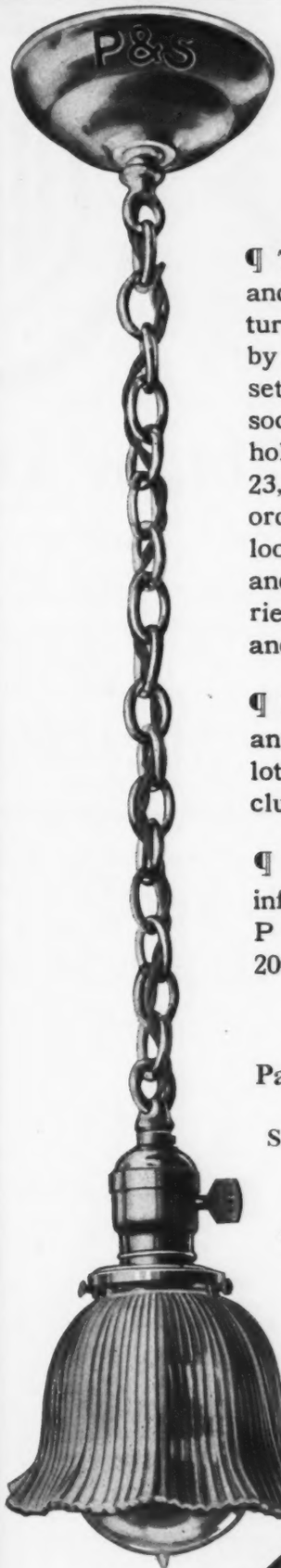
There are enough types of both switchboard and portable Eveready Meters to enable you to select one that is exactly suited to your requirements. Let us send you a copy of our catalogue No 323 which gives the prices.

The Eveready is an exceedingly accurate instrument at a reasonable price.

American Ever Ready Co.

304-322 Hudson Street
New York City

BOSTON **CHICAGO**
NEW ORLEANS **SAN FRANCISCO**



¶ This handsome and inexpensive fixture is easily made by using P & S rosette No. 200, P & S socket with shade holder attached No. 23, along with an ordinary fixture loop, fixture chain and lamp cord carried by all electrical and fixture dealers.

¶ It looks like $5.00 and cost a whole lot under $1 00 including your labor.

¶ Ask us for more information about P & S rosette No. 200.

Pass & Seymour, Inc.
Solvay, New York, U. S. A.

178 Fulton Street, New York City

700 West Jackson Blvd., Chicago, Illinois

Denver Sales Agents, B. K. Sweeney Electrical Company

PASS & SEYMOUR, Inc., Solvay, N. Y.
Send us more information about P. & S. No. 200.
Name.....
Address.....
City.....
State.....
Coupon No. 9.

UNION
TRADE-MARK

You Obtain Absolute Protection

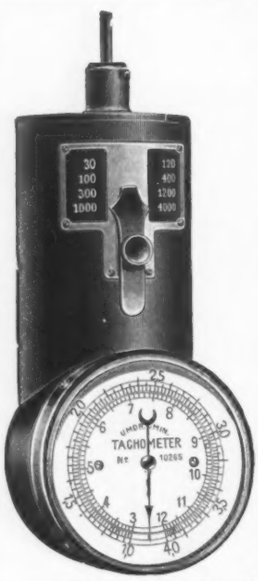
from dangerous excess currents when you use "UNION" Enclosed Fuses on your circuits—a safety valve which does not ignore the fluctuations of current but which responds to the characteristics of the load.

Specify and insist on receiving goods with above Trade-Mark.

BEST BY TEST

1014 W. Congress St. CHICAGO **CHICAGO FUSE MFG. CO.** 1 Hudson Street NEW YORK

"JA-GA-BI" Hand Tachometers



For accurately measuring the r.p.m. of any rotating shaft a JA-GA-BI direct-reading tachometer is most valuable.

Very little hand-pressure is required to apply the instrument to a high-speed motor (for example); and it gives instant results.

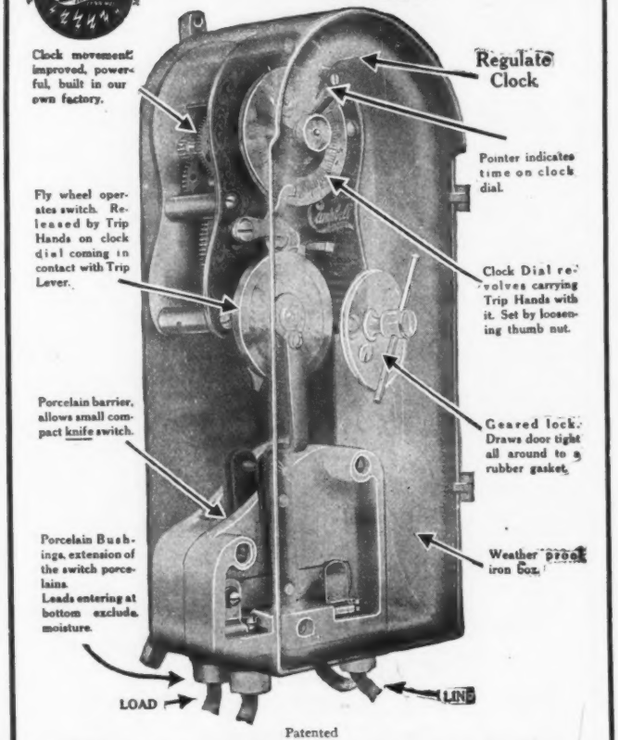
JA-GA-BI tachometers are used by the U. S. Gov't, Universities, Colleges and large Commercial Cos.

We also supply tachometers for belt or direct connection; and especially ask attention to the *Frahm Vibration Tachometers* for *turbo-generator* sets.

Tachometers for all purposes are described in Bulletin 290. Ask for it.

JAMES G. BIDDLE, ELECTRICAL MEASURING INSTRUMENTS
1211-13 Arch Street :: PHILADELPHIA
Be Sure to Visit Our New Exhibition Room.

CAMPBELL TIME SWITCH
THE BEST


Clock movement improved, powerful, built in our own factory.
Regulate Clock
Pointer indicates time on clock dial.
Fly wheel operates switch. Released by Trip Hands on clock dial coming in contact with Trip Lever.
Clock Dial revolves carrying Trip Hands with it. Set by loosening thumb nut.
Porcelain barrier, allows small compact knife switch.
Geared lock. Draws door tight all around to rubber gasket.
Porcelain Bushings, extension of the switch porcelains. Leads entering at bottom exclude moisture.
Weather proof iron box.
LOAD
LINE

Patented

CAMPBELL ELECTRIC CO., Lynn, Mass.
Send For Price List

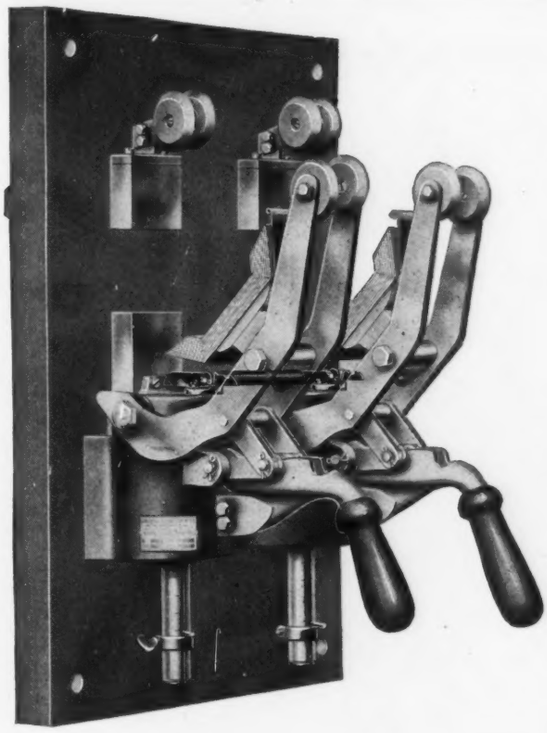
BLOOD WILL TELL

WHEN you buy blooded stock, you want to know its pedigree, because that's the only way you can tell its worth without an actual test. The pedigree of Shawmut Fuses extends back to the days when a fuse was only a chunk of lead—and the stock has kept increasing in value until to-day there is no finer fuse made than the Shawmut.

Condit Electrical Mfg. Co., Boston

Manufacturers of Electrical Protective Devices

New York, 39 Cortlandt St. and 3 W. 29th St.
Philadelphia, 1011 Mutual Life Bldg.
Buffalo, 41 East Eagle Street.
Pittsburgh, 219 Lewis Block.
Cleveland, 1856 East 86th St.
Chicago, 627 West Jackson Blvd.
Atlanta, 702 Empire Bldg.
Kansas City, 618 Dwight Bldg.
Denver, 1621 17th Street.
Seattle, 425 New York Block.
San Francisco, 766 Folsom Street.
Los Angeles, 551 So. Los Angeles Street.
Canadian Representatives: Northern Electric & Mfg. Co., Montreal, Toronto, Winnipeg, Regina, Calgary, Vancouver.

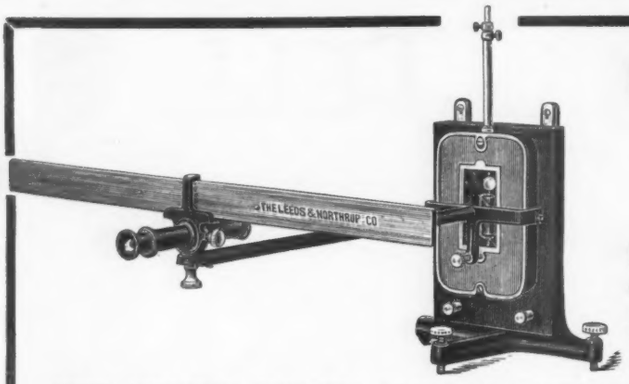


CONDIT'S brush on his "Big C" line doesn't act like a rigid piece of copper—it is flexible, self-cleaning and every leaf makes contact.

And the maximum-contact, minimum-resistance carbon contacts mark the biggest improvement in circuit-breaker construction since the advent of the laminated brush.

Just look at the CONDIT Circuit Breaker shown here—it doesn't look as if made by a blacksmith—but

It Will Stand the Treatment A Blacksmith Would Give It



Galvanometers For Every Service

Note the following distinctive features of our D'Arsonval Galvanometers.

EXTREME SIMPLICITY OF CONSTRUCTION. They are easily set up and manipulated, and all working parts can be readily reached for inspection.

THE MOVING SYSTEM ALWAYS ENTIRELY VISIBLE. This is an advantage which will be appreciated by any user of the numerous types of galvanometers in which the coil is hidden.

NEW SUSPENSIONS CAN BE RAPIDLY PUT IN BY THE USER. The only tools required are a pair of forceps and a watchmaker's screw-driver.

AMPLE COIL CLEARANCE. No delicate adjustment is necessary to allow the coil to swing freely.

REMOVABLE COPPER DAMPER

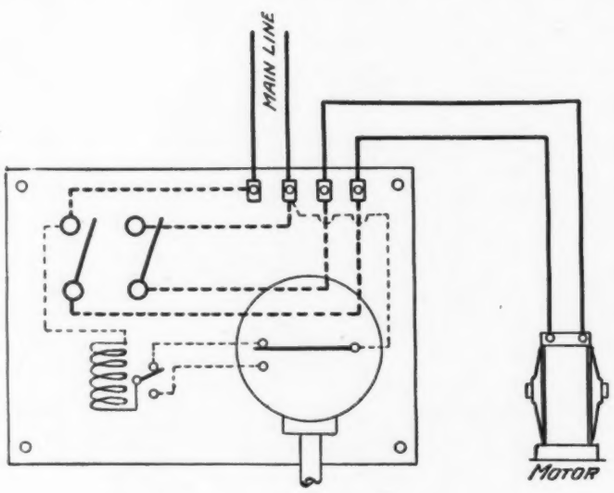
SENSIBILITY up to 1200 megohms depending upon the type of instruments.

Catalogue No. 20 contains much information valuable to those using galvanometers. Free upon request.

We also manufacture Resistance Boxes, Wheatstone Bridges, Cable Testing Apparatus, Standardization Apparatus, Photometric Apparatus, Conductivity Apparatus, etc

The Leeds & Northrup Co., 4903 Stenton Ave., Phila. 5

This Diagram Shows How Simple It Is



to wire up a Sundh Pressure Regulator for starting a small motor without the use of a starting resistance.

The double pole type of Pressure Regulator is shown, but in many cases of Direct Current and single-phase Alternating Current, a single pole type can be used. It may be also adapted for starting A. C. Motors of two or three phases, three wire, or two phases, four wire when it is permissible to open two circuits and to run the neutrals direct to the motor.

The Sundh Catalog contains detailed information. Shall we send it?

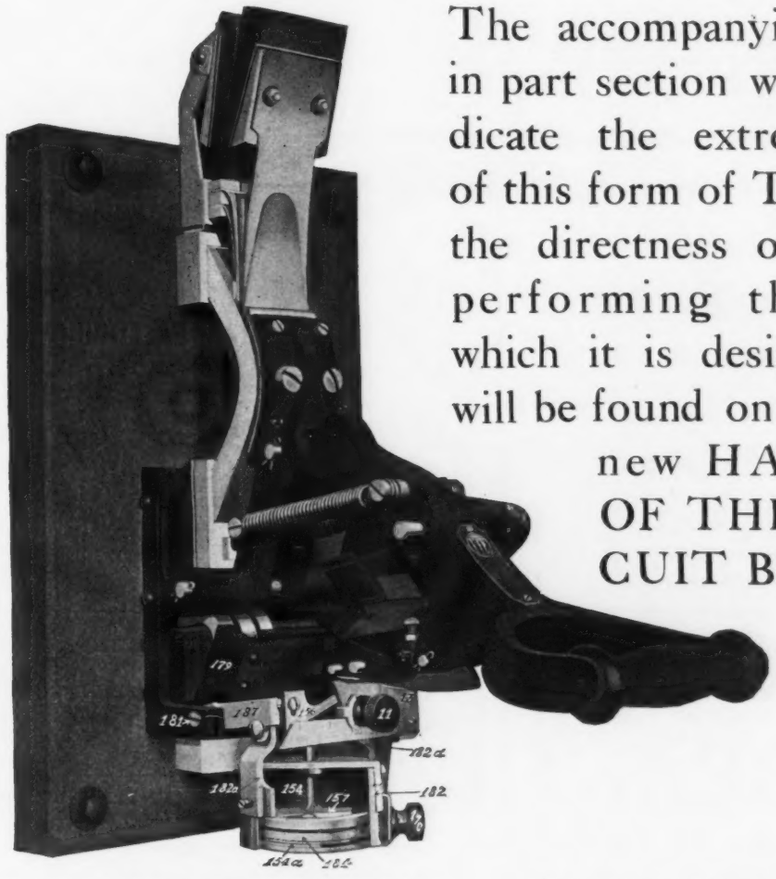
SUNDH ELECTRIC COMPANY

NEW YORK, U. S. A. 2

Electrical Engineers have long recognized the desirability of

I-T-E
Time Limit Circuit Breakers

for many classes of service. It remained, however, for the Cutter Company to meet this need with a Circuit Breaker which is at the same time simple in construction and effective in operation. We call our Time Limit feature the **"Dalite"**



The accompanying illustration in part section will serve to indicate the extreme simplicity of this form of Time Limit and the directness of its action in performing the service for which it is designed. Details will be found on page 46 of the new HAND BOOK OF THE I-T-E CIRCUIT BREAKER.

THE CUTTER COMPANY Main Office and Factory: **PHILADELPHIA**

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Eccles & Smith Co., 71 First St., San Francisco, Cal.
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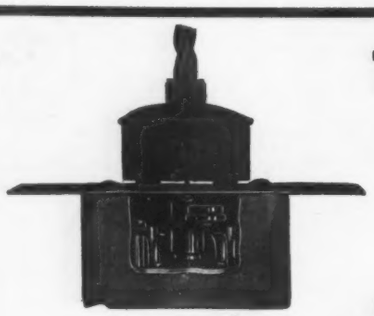
I-T-E Electric Co., 72 Finsbury Pavement, E.C., London.



There are Two Classes

into which all switches and receptacles may be divided—

"Diamond H" Switches and Receptacles

and all others. Our well-known high standard of design, material, construction and test has made the ◇H◇ trade mark the recognized standard of switch and receptacle efficiency for the last dozen years.

You'll find more than seventy styles of switches and receptacles described in the ◇H◇ catalog. If you haven't a copy, write for one to-day.

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New York Boston Chicago Pittsburg San Francisco Denver Toronto London, Eng.

THE
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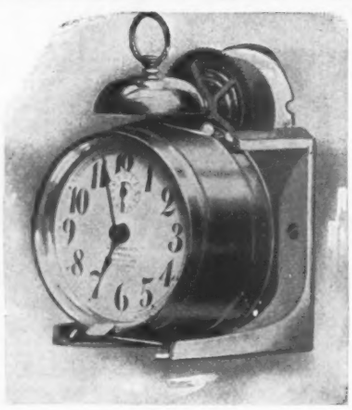
Time Switch

A new switch with new features. Good as well as cheap. It's a seller and it gives satisfaction. Just the thing for the Show Window. Try a few and you will order more.



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1210 RACE ST., PHILADELPHIA, PA.

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7-inch to 36-inch diameter for ocean, lake and river steamers and launches; also electric light plants driven by gasoline engine for isolated lighting.

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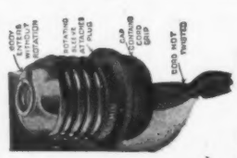

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IN-IM-I-TA-BLE 9-0-3

Write for Quantity Discounts on Your 1912 Requirements.

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A. C. Leslie & Co., Ltd., Montreal, Can.

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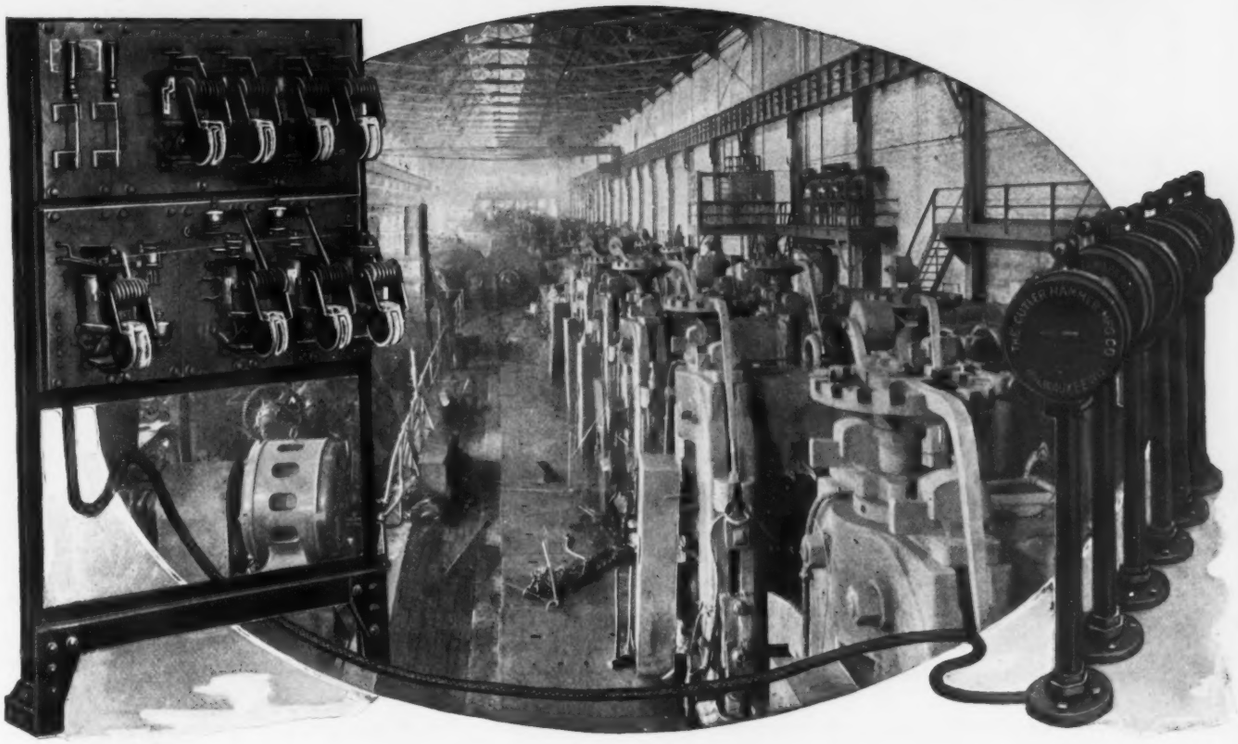

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AND OTHER INDUSTRIAL PLANTS

Cutler-Hammer motor control apparatus represents the result of twenty years' experience in the manufacture of controlling apparatus. We have types for every service in the steel mill or other industrial plant.

There is no other company anywhere that has specialized on controlling apparatus for so long a time as has The Cutler-Hammer Mfg. Co. There is no other company anywhere that has standardized so many different types of controllers. There is no company that can serve you as promptly or so well if you want apparatus for starting, regulating and stopping of electric motors.

Cutler-Hammer master switch type controllers arranged for control by master switch, limit switch, push-button, etc., are particularly adapted for heavy work such as steel mill machinery, coal and ore handling machinery, skip hoists, etc.

Put Your Motor Control Problems up to Cutler-Hammer and you will get information based on experience. Write for Bulletin on Magnetic Switch Type Controllers.

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Imperial Type Voltmeter

Not the Jovian little fellows with spear and barbed tail, but always found in just as good company. We call 'em "Imps" for short though their real name is Imperial.

They are as popular with our customers as with us as they are right in every sense of the word.

Like their Jovian mates they are always on the spot.

Call for them.

PARTIAL PRICE LIST

	4-In. Size	2½-In Size
30 Volts	$8.50	$6.75
125 Volts	10.00	.....
10 Amp.	9.00	6.75
30 Amp.	9.25	7.00

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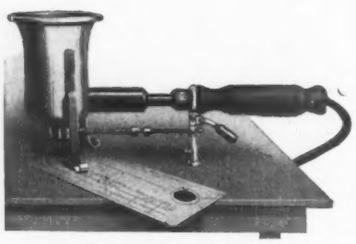
Monadnock Blk. Chicago — 203 Broadway New York — Oliver Building Pittsburg

Vulcan Electric Wax Melter and Dropper

Light
Compact
Speedy
Easy to Use



"The only **Wax Melter** and **Dropper** on the market."

Banks, express offices and shippers of sealed packages the country over need it. Saves time and wax, and is much cleaner than the old method. We are advertising it in leading magazines. All electrical dealers should write for particulars.

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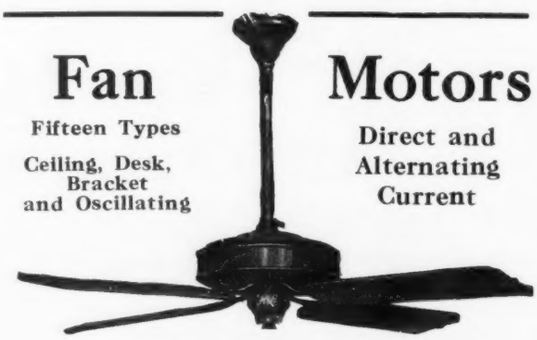
"TUERK" and H&E

Fan Motors

Fifteen Types
Ceiling, Desk, Bracket and Oscillating

Direct and Alternating Current



Alternating Current Ceiling Fan Type "C"

Two speed; four blades with 52″ sweep, operating at 225 R. P. M. Motor *dependable* for continuous service.

"Tuerk" and "H. E." Fans fill all requirements. Get your orders in early. It is the dealer with a stock on hand who does the big Fan business. Distributing agencies in the large centers of United States and Canada.

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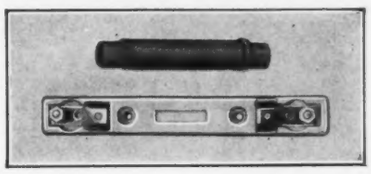
WARD LEONARD

A Convenient Resistance Unit

Made to Fit in Fuse Clips

ENAMELED  ENAMELED

They are made to fit in lamp sockets and have a zero temperature coefficient resistance.

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Resistance wire is fully protected from mechanical, chemical and electrical depreciation by a coating of enamel.

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Ward Leonard Electric Co. **Bronxville, N. Y.**

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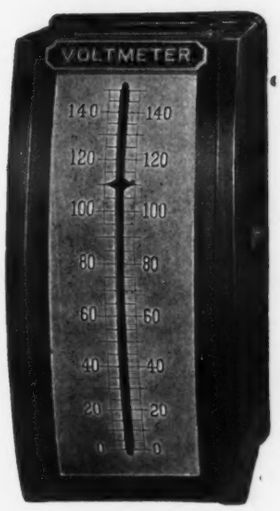

At moderate prices are secured when Keystone Instruments are purchased. A 17-year-old concern with a complete line of Instruments.

Send for new catalogue.

Keystone Electrical Instrument Co.

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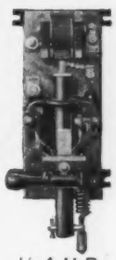

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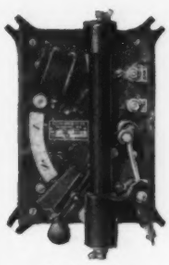
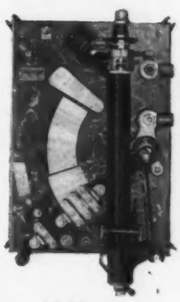


5-10 H.P.



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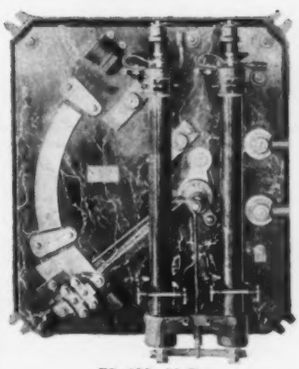

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It is DUST PROOF and MOISTURE PROOF without any extra charge

It DOESN'T NEED FREQUENT REPAIRS nor FREQUENT RENEWAL OF CONTACTS

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Write for Bulletin B2

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renders the water absolutely safe, and is so low in price that it will pay for itself in a few weeks in the saving over the cost of spring water.

It is fool proof and its product is cold, sparkling, palatable, and perfectly healthful.

The cost of operation is insignificant—one gallon of water for about 100 watts. With 10-cent current, this means one cent per gallon.

Its use means closer relations between you and your customers—write to-day for catalog.

Safe Drinking Water

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Throws both Hot and Cold air. Weighs only 2 lbs. Built to run on 110 volts direct and alternating currents; also 220 volts.

The Shelton Electric Vibrators are standard the world over.

We manufacture 20 different styles of massage machines. Dealers! There is money made in selling Shelton Vibrators and Hair Dryers. Agents wanted everywhere. Write for catalog and quotations.

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MANUFACTURERS OF

WHITE CROSS ELECTRIC VIBRATORS

Electric Hair Dryers, Electric Irons, Electric Toaster Stoves, Small Electric Motors.

Send for Catalog No. 59 and Dealers' Discount.

Swedish Movement in your own Rocker.

Any chair can be made a Vibrating Chair with our Vibrators.

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A Full Line of Alternating Current Switchboard Indicating Instruments

Is offered by this company, comprising

WATTMETERS, Single and Polyphase FREQUENCY METERS
POWER FACTOR METERS AMMETERS SYNCHROSCOPES VOLTMETERS
and New Models of Weston D. C. Instruments to match

This whole group of instruments embodies the results of several years' exhaustive study and scientific investigation of all the comp... electrical and mechanical problems involved in the development of durable, reliable, sensitive and accurate instruments for use on alternating current circuits.

Every detail of each of these instruments has been most carefully studied and worked out, so as to be sure that each shall fully meet the most exacting requirements of the service for which it is intended. Neither pains nor expense has been spared in the effort to produce instruments having the highest possible life, the best possible scale characteristics, combined with great accuracy under the most violent load fluctuations and also under the many other trying conditions met with in practical work. Every part of each instrument is made strictly to gauge and the design and workmanship and finish is of the highest order of excellence.

We invite the most critical examination of every detail of each member of the group. We also solicit the fullest investigation of the many other novel features and very valuable operative characteristics of these new instruments, and request a careful comparison in all these respects with any other make of instrument intended for like service. We offer them as a valuable and permanent contribution to the art of electrical measurement. Their performance in service will be found to justify the claim that no other make of instruments approach them in fitness for the service required from A. C. Switchboard indicating instruments.

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Birmingham, Brown Marx Bldg.
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GOOD EQUIPMENT DESERVES GOOD OIL.

Send in your trial order at once.

ANTI-CORROSIVE CYLINDER OIL MANUFACTURED ONLY BY E. H. KELLOGG & CO.

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Established FIFTY-THREE years ago

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Wyckoff Creosoted Conduit for Underground Wires. Millions of feet in use; over 25 years' service without decay; cheapest to lay. Creosoted *Paving Blocks* for yards and buildings. Creosoted Cross Arms, Poles and Lumber.

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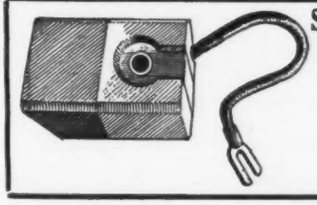

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have been adopted as standard by the largest manufacturers of electrical machinery in the United States.

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Many a Big Company Is Misjudged

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Speedometers.
American Ever Ready Co.

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1 60	National, 3-phase, rev. field, 6600 volts	1200
1 75	Gen. Elec., type AQB, 2-phase, rev. field, 2300 v.	900
1 75	Gen. Elec., type ATB, 3-phase, rev. field, 2300 v.	900
1 75	Westinghouse, type G, 2-phase, rev. field, bracket bearing, 240 v.	900
1 75	Westinghouse, type G, 3-phase, rev. field, bracket bearing, 240 v.	900
1 90	Elec. Mach. Co., 3-phase revolving field, 2300 v.	720
1 100	Ft. Wayne, type WAL, single-phase, rev. arm., comp., 1150 or 2300 v.	900
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1 100	National, 3-phase, rev. field, type RC, 6600 v.	900
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1 100	Westinghouse, 3-phase, revolving field, pedestal bearing, 2300 v.	900
1 100	Gen. Elec., 3-phase, type ATB, form P, rev. field, 1150 or 2300 v.	900
1 120	Gen. Elec., type AS, single-phase, rev. arm., comp., 2300 v.	900
1 120	Westinghouse, 2-phase, rev. field, 2300 v., pedestal bearing	900
1 120	Westinghouse, 3-phase, rev. field, 2300 v., pedestal bearing	900
1 150	Stanley, 3-phase, revolving field, inductor type, 2400 volts	600
1 150	National, 2-phase, rev. field, 2300 v.	720
1 150	National, 3-phase, rev. field, 2300 v.	720
1 150	Westinghouse, 2-phase, rev. field, 2200 v., direct-connected to Erie City Iron Works auto. self-oiling engine	257
1 150	Westinghouse, 3-phase, rev. field, 2300 v., direct-connected to Erie City Iron Works auto. self-oiling engine	257
1 175	Stanley, 2-phase, inductor type, 1150 or 2300 v.	514
3 180	Gen. Elec., single-phase, type AS, rev. arm., comp., 1100 or 2200 v.	600
2 180	Westinghouse, 3-phase, rev. arm., comp., 2200 v.	514
1 200	Western Elec., type S20E0, rev. field, 3-phase, 440 volts	600
3 200	Gen. Elec., type ATB, form D, 3-phase, rev. field, 2300 v.	600

125-133 Cycle Alternators

KVA.		Speed
1 30	National, 1100 v.	1500
1 75	Ft. Wayne, comp.	1050
1 90	Ft. Wayne, 1100 v.	1050
2 90	G. Elec., type AS.	1250

Arc Machines

KVA.		Speed
1 9.6 amp.,	Brush, 13A.	500
1 6.6 amp.,	Brush, 8½B.	750

250-Volt D. C. Generators

KW.		Speed
1 8½	Fairbanks-Morse.	1000
1 10	Holtzer-Cabot	1475
1 10	Westinghouse	825
2 12½	Colonial	1200
1 12½	Westinghouse	1200
1 15	Triumph	1275
1 15	Crocker-Wheeler, direct-connected to Terry steam turbine	2500
1 16	Ft. Wayne	1250
1 17½	Commercial, MP, comp., direct-connected to "Merriam"-Bruce-Macbeth 2 cyl. vertical gasoline engine	300
1 20	Northern	750
1 22½	Crocker-Wheeler	880
1 25	Gen. Elec.	1100
2 25	Allis-Chalmers	750
1 30	Commercial	600
1 30	Elec. Mach. Co.	950
1 30	Northern	1000
2 30	Allis-Chalmers	1300
1 30	Amer. Eng. Co.	750
1 30	Ideal, MP	600
1 30	Gen. Elec.	605
1 35	Northern	1000
1 35	Western Elec.	500
1 42½	Allis-Chalmers	950
1 42½	Allis-Chalmers	650
1 45	Northern	900
1 45	Gen. Elec.	975
1 45	Westinghouse	975
1 45	Westinghouse, direct-connected to Westinghouse Junior engine	330
1 50	Crocker-Wheeler	700
1 50	Northern	675
1 50	C. & C.	650
1 65	Crocker-Wheeler	925
2 65	Gen. Elec.	875
1 75	Gen. Elec.	850
3 75	Westinghouse, MP, comp., engine type, for direct-connection, vertically split-frame, with shaft	200
1 100	Westinghouse, 8-pole, comp., engine type, for direct-connection, vertically split-frame, with shaft.	200

220-V. D. C. Motors

H.P.		Speed
1 1	Sterling	1950
1 1	Peerless, MP	1690
1 1	Crocker-Wheeler, type C	975
1 1	Northern, MP	1400
1 1	Gibbs, MP, type A.	1225
1 1	Lundell	1200
1 1	Browning	1030
1 1¼	Willey, comp.	1250
1 1½	Northern, MP, back-geared	1200-231
1 1½	Diehl, MP, type G	460
1 2	Browning	2260
1 2	Thompson	1250
4 2	Hobart	1580
1 2	Peerless, MP	1650
1 2	Gen. Elec., type CQ.	1900
4 2	Gen. Elec., type CA	1800
1 2	Watson, MP	1200
1 2	Westinghouse, MP, type S	1200
1 2	Ft. Wayne, type L.	1150
1 2	Northern, MP	255
1 3	Phoenix, new	1800
1 3	Fairbanks - Morse, MP	1750
2 3	Bartz - Wygant & Brown, MP	1525
1 3	Peerless, MP, comp.	1850
1 3	Sturtevant, MP.	1700
1 3	Quaker City, MP.	1150
1 3	Colonial, MP.	1760
1 3	Willey, MP.	1460
1 3	National Stamping Co., type M.	1150
1 3	Westinghouse, MP, type S.	1800
6 3	Gen. Elec., type CE	1750
1 3	Westinghouse, MP, type M.	1700
1 3	Gen. Elec., type CVC, interpole.	1650
1 3	Western Elec., type NI	1150
1 3	Watson, MP.	1200
1 3	Willey, MP.	600
1 3½	Diehl, MP, type E7	470
1 3½	Triumph, round frame	1525
1 4	New England, type E	1700
3 4	Phoenix, new.	1800
1 4	Bostedo, MP.	840
1 5	Allen, MP.	2000
1 5	Fairbanks - Morse, MP	1650
1 5	Card, MP.	925
1 5	Browning, MP.	1550
1 5	Amer. Eng. Co., MP	1300
1 5	Hobart, MP.	1200
1 5	Phoenix, MP, comp.	925

H.P.		Speed
1 5	Gen. Elec., type CE	1650
13 5	Gen. Elec., type CQ	1650
1 5	Westinghouse, MP.	1600
2 5	Colonial, MP.	1260
1 5	Watson, MP.	1150
2 5	Colonial, MP.	1050
1 5	Peerless, MP.	1000
1 5	National, MP.	950
1 5	Westinghouse, MP.	1300
1 5	Gen. Elec., MP.	1000
1 5	Browning, MP.	920
3 5	Gen. Elec., type CQ	1100
1 5	Crocker-Wheeler	980
1 5	Gen. Elec., MP.	600
1 5	Browning, MP.	500
2 5½	Gen. Elec., MP.	900
1 7½	Phoenix, MP.	1500
1 7½	Reliance, MP.	1200
1 7½	Fairbanks - Morse.	1500
1 7½	Aaron, MP.	800
4 7½	Gen. Elec.	1525
4 7½	Gen. Elec.	1525
1 7½	Western Elec., MP.	1475
1 7½	Triumph, MP.	1350
1 7½	Fairbanks - Morse, MP	1350
2 7½	Northern, MP.	1300
1 7½	Peerless, MP.	960
1 7½	Commercial	900
8 7½	National, MP.	1100
3 7½	Sprague-Lundell	1070
20 7½	National, MP.	900
1 7½	Westinghouse, MP.	975
1 7½	Crocker-Wheeler	875
1 7½	Western Elec., MP	550
1 7½	Commercial, MP.	540
1 7½	Northern, MP.	450
1 8	Western Elec.	1500
1 8	Westinghouse	835
1 10	Milwaukee, MP, series-wound	600
1 10	Reliance, MP.	1200
1 10	Fidelity, MP.	1200
1 10	Akron, MP.	1100
1 10	Cincinnati, MP.	1050
1 10	Western Elec., MP.	1550
9 10	National, MP, new.	1500
1 10	Milwaukee, MP.	1000
1 10	Roth, MP.	1275
1 10	Peerless, MP, comp.	1260
1 10	Allis-Chalmers, MP.	1150
2 10	Sprague - Lundell, encl.	1070
1 10	Gen. Elec., MP.	1375
1 10	Fairbanks - Morse, MP, comp.	900
1 10	Lundell, MP.	850
1 10	Gibbs, MP, type A.	750
1 10	Western Elec., MP.	750
1 10	Allis-Chalmers, MP.	1050
1 10	Allis-Chalmers, MP	950
2 10	Western Elec., type NI	950
58 10	National, MP, new	800
1 10	Roth, MP.	800
8 10	Gen. Elec., MP.	1250
1 10	Westinghouse, MP.	1150
1 10	Jenney, MP.	700
1 10	Crocker - Wheeler, MP	850
1 12	Westinghouse, MP.	700
1 12½	Western Elec., MP	800
1 15	Northern, MP.	1550
1 15	Triumph, MP.	1100
2 15	Colonial, MP, comp.	1040
1 15	Fairbanks - Morse, MP	800
1 15	Western Elec., MP	800
1 15	Ft. Wayne, MP.	875
1 15	Northern, MP, comp.	725
2 15	Gen. Elec., MP.	1000
27 15	National, MP, new	725
1 15	Westinghouse, MP.	1000
1 20	Aaron, MP.	750

J. WARREN ARCHER C. M. BALDWIN

ARCHER & BALDWIN

114-118 LIBERTY STREET, ROOM No. 303 PHONE, RECTOR 4337-8-9 **NEW YORK CITY**

BELTED A. C. GENERATORS, 3 PHASE

3—300 K.W., A.T.B., Gen. Elec., 450 RPM., 2300 volts.
3—200 K.W., A.T.B., Gen. Elec., 600 RPM., 2300 volts.
1—175 K.V.A., Westg., rev. field, 900 RPM., 2300 volts.
3—100 K.W., A.T., Gen. Elec., 900 RPM., 2300 volts.
1— 60 K.W., rev. field, Allis-Chalmers, 1200 RPM., 2200 volts.
1— 50 K.W., A.T.B., Gen. Elec., 1200 RPM., 2300 volts.

BELTED A. C. GENERATORS, 2 PHASE

2—220 K.W., Stanley, 666 RPM., 1200 volts.
3—200 K.W., Gen. Elec., A.Q.B., 600 RPM., 2200 volts.
1—175 K.W., Westg., rev. field, 900 RPM., 2200 volts.
1—150 K.W., Stanley, 800 RPM., 2400 volts.

2 AND 3 PHASE A. C. MOTORS

5 H.P., General Electric, 2-phase, 60 cycles, 220 volts, 1200 RPM.
15 H.P. General Electric, 2-phase, 60 cycles, 220 volts, 1200 RPM.
50 H.P. Westinghouse, 2-phase, 60 cycles, 200 volts, 850 RPM.
75 H.P., General Electric, 2-phase, 60 cycles, 200 volts, 450 RPM.
2—200 H.P. Westinghouse, 2-phase, 60 cycles, 400 volts, 495 RPM.
2 H.P. General Electric, 3-phase, 60 cycles, 110 volts, 1800 RPM.
10 H.P., Hawthorne, 3-phase, 60 cycles, 440 volts, 1200 RPM.
35 H.P. Fairbanks, 3-phase, 60 cycles, 220 volts, 900 RPM.
50 H.P., Fairbanks, 3-phase, 60 cycles, 220 volts, 900 RPM.
75 H.P., General Electric, 3-phase, 60 cycles, 220 volts, 514 RPM.
100 H.P., General Electric, 3-phase, 60 cycles, 550 volts, 720 RPM.

HUDSON TERMINAL BLDG.

DUZETS & SON

NEW YORK

6 SPECIALS

Two 135 K. W. Stanley 2 or 3 phase, 60 cycle, 2300 volt alternators, with exciters; also two 16 x 20 Russell 4 valve engines, late type.

100 H. P. Scotch marine boiler, insured 125 lbs. Hartford, 18 months old, $500.

72 H. P. Foos gas or gasoline engine, 3 cyl. ver., dir. con. 50 K. W., G. E. 125 volt dynamo, used one year, $1,600.

100 K. W. Wghse. revolving field, 2 or 3 phase, 60 cycle, 2300 volt generator, with rheostat, $650.

175 K. W. Wghse., 2 phase, 60 cycle, 2200 volt; dir. con. Buckeye tandem engine with exciter, switchboard and condenser, $2,300.

100 K. W., G. E. type "AQB," 2 phase, 60 cycle, 2300 volt generator with exciter and S.B., $600.

Send for complete BARGAIN LIST of Electrical and Steam Machinery

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Second-Hand Electrical and Steam Machinery of all Kinds. We can make prices on the following, which will save you from 50 to 60 per cent of the cost of new.

Direct Connected D. C. Units

K.W.	Make	Volts	Poles	R.P.M.	Make of Engine
3—600	Westg.	250–125		150	22&46x24 Vert. Ball & Wood Cor. C.C.
500	Westg.	125	20	150	20&42x30 G.L.E.W. Vert. Cor. C.C.
3—500	Gen. Elec.	550	10	100	18&36x48 Hamilton Hor. C.C. Cor.
400	Gen. Elec.	250–125	14	120	18&36x30 Allis Vert. C.C. Corliss
3—400	Ft. Wayne.	250	10	115	20&42x30 G.L.E.W. Vert. C.C. Co
350	Westg.	250	8	120	24x36 St. Louis Horiz. L.H. Cor.
2—200	Gen. Elec.	250–125	6	245	18x16 Harrisburg 4-Valve Horiz.
200	Gen. Elec.	220	6	200	16&24x18 Erie Ball Vert. C.C.
150	Westg.	250	8	280	13x14 Ideal Horiz. Center Crank
125	Walker	250	6	125	16x36 Allis Corliss Right Hand
2—25	Ft. Wayne	125	8	250	16x16 Erie Ball Self-Oil. Enc.
100	Sprague	250–125	6	150	Ball & Wood Horiz. Cor. Type
100	Gen. Elec.	125	6	270	15x14 Ideal Horiz. Center Crank Hor.
56	Westg.	250–125	6	290	11x12 Westg. 3-Cyl. Gas Engine
55	Westg.	125	6		Harrisburg Horiz. Simple Engine
2— 50	Triumph	125	6		12x12 Russell Single Valve Engines
40	Comm. Elec.	250	4	300	11x16 Chan.-Taylor Hor.
40	Comm. Elec.	125	6	300	Brownell Center Crank Simple Eng.
35	Westg	250	6	290	11x12 Westg. 2Cyl. Gas Engine
35	Triumph	250		300	11x10 Chan.-Taylor Enclosed
2— 25	Gen. Elec.	125	6	294	7x10 Chuse Slide Valve Enc.
20	Gen. Elec.	125	6	360	9x7 Gen. Elec. Vert. Marine Type

Direct Connected D. C. Units

75 K.W. General Electric 125 V. 2400 RPM. Curtis turbine.
100 K.W. General Electric 125/250 V. 250 RPM, Tandem comp. Watertown Eng.
125 K.W. Sprague Electric 125/250 V. 250 RPM, Simple Ball & Wood Engine.

Belted D. C. Units

100 K.W. Westinghouse 250 V. 550 RPM, 6 pole.
150 K.W. Eddy 250 V. 550 RPM, 4 pole.
250 K.W. 125 V. 350 RPM, Thresher, condition like new.

Direct Connected A. C. Units

150 K.W. General Electric revolving field, 2300 V., 225 RPM, 14 x 22 x 16 Buffalo Forge Tand. Comp. Eng.

Belted A. C. Generators

300 K.W. 2300 V. 3-phase, 25-cycle, 350 RPM, General Electric.
75 K.W. General Electric 2200 V. 900 RPM, Revolving field 3 phase.
75 K.W. Allis Chalmers 220/440 V. 900 RPM, Revolving field 3 phase.
60 K.W. Allis Chalmers 220/440 V. 1200 RPM, Revolving field 3 phase.
60 K.W. Allis Chalmers 2200 V. 1200 RPM, Revolving field 3 phase.
500 other motors and generators, also transformers. Send us your requirements, we buy and sell.

GEORGE SACHSENMAIER & CO., 143 North 3rd St., Philadelphia, Pa.

FOR SALE

1—60 KW., 2-Phase, 60-Cycle, 1100-2200 volt Stanley Generator; make offer. F. O. B., Brooklyn. N. Y.

ADDRESS NO. 9836, CARE OF ELECTRICAL WORLD, N. Y.

350 K. W.

250 Volt Direct Current Generator

direct connected to 24x36 St. Louis Corliss Engine Balancing Set.

417 Pine St—ARTHUR S. PARTRIDGE—St. Louis

Over Half the Readers

of the advertising pages depend upon illustrations to attract them. Are your advertisements "attractive"?

WANTED

TO BUY OR LEASE SMALL ELECTRIC LIGHT PLANTS

If your plant is not paying you I will tell you why, and can make it pay both of us.

H. T. BROWN, M. E. E. E. 700 Broadway, Nashville, Tenn.

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words, two cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

SUPERINTENDENT of lighting and power company desires change. Associate A. I. E. E., technical education, age 26; salary $1,500. Address No. 393, care of Electrical World, New York.

ELECTRICAL ENGINEER, at present holding responsible position with a firm of contracting engineers, desires a change, preferably to Western territory. Eighteen years' European and American experience in power house design and operation, high and low tension, light and power distribution, including electric railroad work. Excellent reputation as an executive and business manager. Address NO. 380, care of Electrical World, New York.

TECHNICAL GRADUATE of 25 (Cornell), with four years' practical electrical-testing experience on switchboard, dynamos and meters, desires position where above qualifications are necessary. Construction or operating work preferred. Can furnish good references. Address No. 383, care of Electrical World, New York.

WANTED—Position as road salesman with electric supply house; experienced in electric and telephone supplies; at present employed. Address No. 384, care of Electrical World, New York.

POSITION with power and lighting company as power solicitor or purchasing agent in Michigan or adjacent territory. Seven years' experience with references. Address No. 387, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

YOUNG MAN, 26, technical college education, 3 years in responsible position with large electrical supply company in Chicago, desires position with good future with electrical or mechanical firm; exchange references; at present employed; at liberty after July 1. Address No. 388, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

DO YOU need a $200 construction and operation man? One who has plenty of ginger, can handle all makes of apparatus, all sizes, has good control over men. Four years' active experience, technical education; best references from present employers. At present operating 9000 KW. plant just completed. Address reply to No. 394, care Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

WANTED—Position to take charge of electrical work of street railway and lighting company; 8 years' experience high and low tension, central and sub station operating, maintenance of car equipment and overhead trolley construction; references. Practical experience with all street railway work. Address No. 391, care of Electrical World, New York.

METER MAN, with 4 years' experience on electric meters and instruments, desires change of location. Would like to hear from any one needing expert meter man or foreman. Location no barrier. Can handle any types or makes. Best references. Address No. 392, care of Electrical World, New York.

TROUBLE EXPERT and construction engineer, 6 years' experience, technical graduate, 28, capable of taking charge of any A.C. or D.C. equipment, make repairs and handle men, would like position as chief electrician or electrical superintendent with large firm; best references; at present employed with large manufacturing concern. Address No. 376, care of Electrical World, New York.

MANAGER of Ice and Electric Co. in the South would like to locate near the Pacific Coast, either U. S. or Canada. Have had full charge of present company for five years. Would accept small salary with percentage of profits. Address No. 356, care of Electrical World, New York.

WANTED—As superintendent of large plant, by a man 39 years of age, who has devoted his entire time since leaving school to the steam and electrical engineering work. A man capable of producing results, well posted in line construction work; ten years' service in last position. Address No. 371, care of Electrical World, New York.

MANAGER of a small New England company wishes to make change; technical graduate; 12 years' experience in electrical manufacturing; location no object. Address No. 404, care of Electrical World, New York.

ELECTRICAL ENGINEER; technical graduate; 30 years old; extensive experience in electrical design of dynamos and motors; familiar with materials and shop methods; would like position with reliable firm who desire a man to produce results. Address No. 401, care of Electrical World, New York.

POSITION WANTED—With gas and electric light company as solicitor; applicant has had 12 years' experience in new-business department; thoroughly familiar with office end of central station work. Address No. 397, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

DESIGNING electrical and mechanical engineer; 10 years' experience in two largest electrical companies of U. S.; Mass. Inst. Tech. graduate; experienced in design of all types of D.C. and A.C. motors and generators; also traction equipment; specialty, commutating pole apparatus. Address No. 400, care of Electrical World, New York.

POSITIONS VACANT

The rate for "Positions Vacant" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

INSTRUCTORS, PROFESSORS and Assistant Professors wanted for engineering positions. Every Spring and Summer we are flooded with inquiries from the various technical colleges of America for men experienced as Instructors in Mechanical, Civil, Structural, Mining, Chemical, Electrical and Hydraulic Engineering. We handle engineering exclusively. Investigate our methods. The Engineering Agency, Inc. (Est. 1893), Monadnock Block, Chicago.

ELECTRICAL ENGINEER—A well established company in New England desires the services of an engineer who can handle the electrical design of slow and high speed D. C. motors and generators up to 100 K. W. capacity. State experience and when available. Address 345, care Electrical World, New York.

ELECTRICAL and mechanical draftsmen, designers and detailers wanted for positions. We handle only technical men, or men with technical experience. The Engineering Agency, Inc. (Est. 1893), Chicago.

WANTED by an electric light, gas and power company in Central Pennsylvania with service in several towns, a man competent to organize and take charge of a new business department—both gas and electricity. This man should be able to organize this department and also do soliciting himself. Apply with references, experience and salary expected to No. 354, care of Electrical World, New York.

WANTED—Salesman to travel in the South with a line of electric light, telephone and railway supplies. Would prefer a man acquainted with the territory, but will consider an applicant who knows prices and has sales ability. State age, experience, references and salary. Address No. 381, care of Electrical World, New York.

WANTED—First-class electrical draughtsmen, having experience in machine design. In applying state experience, where at present employed and salary expected. Address No. 386, care of Electrical World, New York.

DRAFTSMEN—Experienced men wanted on motor, controller and general machine design. No replies considered unless experience, age and salary expected are given. Address No. 385, care Electrical World, New York.

WANTED—Assembling foreman for concern manufacturing high grade small electrical apparatus in large quantities. Man must be good bench hand, energetic, used to fine interchangeable work, and familiar with piece work or premium system. P. O. Box 43, Springfield, Mass.

WANTED—Assistant engineers in motor designing department. Both alternating and direct. State age, experience and salary expected. Address No. 379, care of Electrical World, New York.

WANTED—Mechanical Draftsmen, experienced in the design of Motors, Generators and Detail Apparatus, such as Controllers, Switchboards, Circuit Breakers, etc. State experience and salary expected. Address CHIEF CLERK, Engineering Department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WANTED—Foreman for department machining hard rubber and other insulating parts. Must be familiar with bench, lathe and drill work on similar material and used to quantity work of very accurate character. In your reply state age, nationality, former places and periods of employment and salary desired. P. O. Box 43, Springfield, Mass.

WANTED—Experienced designer on single-phase alternating-current motors 2 hp. and smaller. State technical training, experience and salary expected. Address No. 333, care of Electrical World, New York.

AN EASTERN technical college requires the services of a high-grade young man for the position of instructor in electrical engineering; must be graduate of technical school of high standing; have had some teaching experience and one who is interested in wireless telegraphy preferred; salary for first college year, about $1,000. Address 403, care Electrical World, New York.

ESTIMATOR for electrical contractor, experienced with building conditions in and about New York City; must have good practical knowledge of electrical contracting work and must be a hustler; state experience; give references, also salary expected. Address No. 321, car of Electrical World, New York.

A COMPANY operating in the Central States would like to secure the services of an experienced man capable of installing, repairing and calibrating switchboard A.C. and D.C. meters and instruments, principally of the Westinghouse, Weston and General Electric types, on high and low potential systems; only detailed applications considered. Address No. 399, care of Electrical World, 1570 Old Colony Building, Chicago, Ill.

WANTED—Experienced power-house draftsman; must be able to lay out foundations, buildings, piping, machines, conveyors, etc.; state references, previous experence and salary expected. Address No. 398, care of Electrical World, New York.

(*Continued on page 78*)

RECO FLASHERS For Electric Signs

increase attractiveness a hundred-fold; save one-half of current bills.

Secure Bulletins showing our immense line, also sign suggestions.

REYNOLDS ELECTRIC FLASHER MFG. CO. Largest Manufacturers of Flashers in the World. Also Manufacturers of Time Switches, Billboard Reflectors, Transformers, etc. 617-631 W. Jackson Blvd., Chicago. 1123 Broadway, N. Y.

Rose Polytechnic Institute

Terre Haute, Indiana

A College of Engineering; courses in Mechanical, Electrical, Civil and Chemical Engineering and Architecture. Extensive shops, well-equipped laboratories in all departments, expenses low. 29th year. For catalogue containing full information and professional register of alumni, address

C. L. MEES, President

Frank MacGovern
Pres.-Gen. Mgr.

MacGOVERN & COMPANY, INC.,

John Mayer, Jr.
Vice-Pres.-Treas.

114 Liberty Street, New York City, Phone 3375-3376 Rector

TURBINE UNIT

1 650 KVA. WESTINGHOUSE-PARSONS TURBO-GENERATOR, 3 PHASE, 60 CYCLE, 2300 VOLTS, 3600 RPM., EQUIPPED WITH DEANE JET CONDENSER. LATEST TYPE; SEEN LESS THAN TWO YEARS' SERVICE.

TUB TRANSFORMERS

2 100 Light (68 KW.) G. E., type R, 60 cycle, 2300 volt, 7.5 amp.
1 75 Light (51 KW.) G. E., type R, 60 cycle, 2300 volt, 7.5 amp.
300 General Electric, series, A.C. arc lamps, 7.5 amp.

A. C. GENERATORS, BELTED, 60 CYCLE

2 300 KW. GEN. ELEC., 3 PH., 2300 V., REV. FIELD, LATEST TYPE, ATB 16-300-450, FORM P.
2 180 KW., Westg., 3 phase, 2300 volts, 514 RPM.
1 150 KW., Bullock, 3 phase, rev. field, 2300 volts, 900 RPM.
2 150 KW., Gen. Elec., single phase, 2300 volts, 650 RPM., first-class condition. $400 each.

D. C. GENERATORS AND MOTORS, BELTED

1 200 KW., Ft. Wayne, 125 volt, 8 pole, MPL, 550 RPM.
2 150 KW., G.E., CL-B, 250 volt, 500 RPM.
1 100 KW., Ft. Wayne, 250 volt, MPL., 550 RPM.
1 100 KW., Gen. Elec., MP, 550 volt, 650 RPM.
1 90 KW., G. E., CL-B, 250 volt, 750 RPM.
3 75 HP., Westg., 220 volt, shunt wd., 475 RPM. Latest type, practically new.
1 25 H.P., G.E., CL-B, 500 volt, 675 RPM.
1 25 H.P., G.E., CL-B, 250-volt, 635 RPM.

DIRECT CONNECTED DIRECT CURRENT UNITS

1 125 KW., Crocker-Wheeler, 240 volts, 522 amp., 250 RPM., 8 poles, dir. conn. to 16½" x 15" Harrisburg engine.
1 60 KW., Fort Wayne, 125-v., compound wound, 200 RPM., direct connected to 14" x 16" engine.
1 40 KW., General Electric, 125 volt, 320 amp. 6 pole, 300 RPM. direct connected to 12 x 12 Ames engine.

Write for our new illustrated catalogue, just out, also special list of small D. C. and A. C. Dynamos and Motors.
Please Send us detailed information regarding any motors, generators, engines, etc., you may have for sale or wish to purchase

We have the following second-hand machinery in good operating condition which must be disposed of within the next thirty days to give possession of the building. Anyone desiring a real bargain will do well to wire us at once:

1—120 K.W. G. E. Alternator, 1100 V., 133 cy., with pulley, rails, exciter and rheostat.
1—160 H.P. Westinghouse Automatic Compound Engine.
1—250 H.P. Westinghouse Automatic Compound Engine.
1—400 H.P. Westinghouse Automatic Compound Engine.
1—12" Austin Oil Separator.
1—7¼ x 5 x 6 Worthington Duplex Pump.
3—9.6 Amp. Duncan D.C. Meters for series arc lamps.

CRAWFORDSVILLE ELECTRIC LIGHT & PWR. CO., 118 N. Green St., Crawfordsville, Ind.

To ENGINEERS and MANUFACTURERS

Temporary or permanent offices completely furnished can be rented in the most desirable building in New York at prices ranging from $15.00 to $40.00 per month. All facilities, private phone, stenographer, typewriters, all engineering journals, directories, etc.

Address: MANUFACTURERS' LIBRARY
Hudson Terminal Building, 50 Church Street

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The Coal & Iron National Bank

143 LIBERTY STREET, NEW YORK

CAPITAL $1,000,000. **SURPLUS AND PROFITS** $335,000

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire.
All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting.
Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick 50c PER STICK $5.00 PER DOZ.

For Sale by all Supply Houses, or **K. McLENNAN & CO.** Sole Manufacturers
Room 411—130 Dearborn St., CHICAGO

We Finance
Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us.

Electric Bond and Share Company

Paid-up Capital and Surplus, $7,800,000

71 Broadway, New York

Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks.

POSITIONS VACANT

(Continued from page 76)

WANTED—Switchboard salesman with experience, for territory 200 miles radius from Philadelphia; state salary desired and past experience. Address No. 396, care of Electrical World, Real Estate Trust Bldg., Philadelphia, Pa.

WANTED—Several good mechanical draftsmen. Address Chief Draftsman, Steam Turbine Department, care Receivers, Allis-Chalmers Co., West Allis, Wis.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y.—Courses in Civil, Mechanical and Electrical Engineering and General Science, leading to the degree of Civil Engineer (C.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), and Bachelor of Science (B.S.). Special courses in Engineering and Science. Splendidly equipped new engineering laboratories. Send for catalogue to the Registrar.

METERMEN WANTED to enroll for complete practical course on "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for booklet, "Instruments and Meters," giving full information. Fort Wayne Correspondence School, No. 913 Shoaff Bldg., Fort Wayne, Ind.

BLISS ELECTRICAL SCHOOL, Washington, D. C.—Course complete in one year. Thorough—practical—scientific. Theoretical and applied electricity, mechanical drawing and necessary engineering knowledge. No superficial or non-essential studies. Actual construction, installation and testing. For young men of energy and character. In the heart of America's scientific enterprise and research. Opens Sept. 25. Write for catalogue. Address 25 Takoma Ave.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Registered Patent Attorney, Washington, D. C., solicits correspondence with inventors, experimenters and corporations. Patents obtained giving broad protection. Laboratories especially adapted for developing inventions to best commercial forms, and for testing and constructing telephonic, electrotherapeutic, optical and general scientific apparatus. Advice free as to patentability, value of inventions and general charge.

FOR SALE—An established electric fixture and contracting business, located in an Iowa town of 16,000 that is doing a lot of building. Owner has larger interests that demand his attention. For terms, etc., address No. 327, care of Electrical World, New York.

FOR SALE—An Electric Light Plant on a paying basis in a growing North Carolina town. Good proposition for anyone with about $5,000. Owner has other business. Address 377, care of Electrical World, New York.

WANTED by a London firm of electrical engineers, a selling agency for the United Kingdom for electrical signs. Apply with catalogues and full particulars to Wm. Geipel & Co., St. Thomas Street, London, S. E.

$10,000 will buy partner's interest in an electrical machinery contracting and repair business; located in New York City; established over 10 years, and pays 25 per cent; partner wishes to retire; this is a good opportunity for bright man. Address No. 8540, care of Electrical World, New York.

CAPITAL WANTED

to finance additional contracts of established electrical contracting company; now doing large jobs. Address No. 405, care Electrical World, New York.

GOOD chance for central lighting system in town of 1,000 population; two lines R. R.; two towns each 500 population, each seven miles away; free building site on right of way; no taxes for ten years; long time franchise. Town now paying nearly 1,000 dollars per year upkeep on gas lights, and will give liberal street lighting contract; part of capital can be raised here. Anyone interested, write A. C. JARVIS, Humeston, Iowa.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

TREASURY DEPARTMENT, OFFICE OF the Supervising Architect, Washington, D. C., June 15, 1912. Sealed proposals will be received at this office until 3 o'clock P. M. on the 24th of July, 1912, and then opened, for furnishing and installing lighting fixtures in the new United States postoffice at New York, N. Y., in accordance with drawings and specification, copies of which may be obtained at this office at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

LEGAL NOTICE

ADVERTISEMENT FOR BIDS.

Sealed bids will be received by the Clerk of the Incorporated Village of Wilmington, State of Ohio, at the Mayor's office, until 12 o'clock, noon,

TUESDAY, JULY 9, 1912,

for the purpose of lighting the streets, alleys, public grounds and places of the Incorporated Village of Wilmington, Ohio, according to the plans and specifications on file in his office.

Each bid must contain the full name of every person or company interested in the same and be accompanied by a certified check in the sum of $5,000.00 on one of the Banks in Wilmington, Ohio, as a guarantee that if the bid is accepted, a contract will be entered into and its performance properly secured.

Should any bid be rejected, the money will be forthwith returned to the bidder, and should any bid be accepted, the money will be returned upon the proper execution and securing of the contract.

The Council reserves the right to reject any and all bids.

By Order of the Council of the Village of Wilmington, Ohio.

FRANK BABB,
Clerk.

June 7, 1912.

When you have equipment you don't want—

When you have need for equipment and material—

Tell Electrical World Readers

These pages are a clearing house and exchange market for the electrical industry.

Manufacturers, Stations, Municipalities and others often have useless material and equipment lying about.

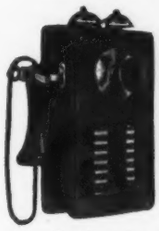
But what one doesn't want may be just what another man needs. For Sale ads. in the World bring buyer and seller together.

If you can't find just what you want advertised here, a World Want Ad. will find it for you.

A New Deal For Live Dealers

Better Prices—Better Quality—Modern Equipments More Systems—No Sales Restrictions—Advertising Assistance—Prompt Shipments—Liberal Terms

Code No. 903



12 Station Set.

Inter-Comm-Phone Systems. An inter-communicating telephone system employing a full metallic circuit between all stations in the system. Automatic key for ringing and selecting. Desk Telephones are in four sizes—6, 12, 22 and 32 station capacity. Non-Flush Wooden Wall Telephones—6, 12, 22 and 32 station capacity. Metal Flush Type Telephones, three styles—6, 12 and 22 station capacities. Cables, battery boxes and all accessories of our own desi n and make. Inter-Comm-Phones to connect with Independent Automatic and Manual Central Office Exchange Systems.

Code No. 905

6 Station Set.

Private Line—Two Way Telephone System—Known as the "Little Time Saver" from house to garage or other purposes where only two instruments are required. Either station can call the other and talk. Wiring includes a pair for talking and one signal wire. Standard transmitter and receiver. Two Desk Type Telephones for same system.

Code No. 965

Private Line. Two-way.

Code No. 964

6 Station Set.

Common Talking—Selective Ringing Telephone System—The selective ringing feature enables one to call any station in the system without disturbing the other, and common talking which permits of but one conversation being carried on at a time. Standard transmitter and receiver. Wall and Desk Type Telephones for 6 and 11 station capacity systems.

Code No. 971

10 Station Set.

Common Talking—Selected Ringing Telephone System—With Common Battery Central Exchange Connection. Same as above with the new additional feature of enabling any station calling City or Main Exchange by signalling over a button designated "Exchange" button. Something all other systems lack, unless imitated soon. Wall and Desk Type Telephones for 5 and 10 station capacity systems.

Code No. 969

Station Set.

Common Talking—Central Station Telephone System—Any station calls the Central Telephone and is connected with any other party at will of Central Telephone attendant. Common talking pair for all stations and individual signal wire from Central Telephone to each Station Telephone. For Schools and Factories where this central control feature is useful. All types and unlimited capacity.

We will refer you to thousands of the largest business concerns in the country that own and operate a Stromberg-Carlson Private Telephone System and prefer it to any other.

Send For Booklet No. 2907 and Dealers' Proposition.

Stromberg-Carlson Telephone Mfg. Co

Rochester, New York, U. S. A.

Chicago, Ill. **Toronto, Can.** **Kansas City, Mo.**
Los Angeles, Cal. **San Francisco, Cal.** **Seattle, Wash.**

The Ideal "Off-Peak" Load

is found in charging the batteries of electric trucks—and a little intelligent effort on the part of almost any Central Station is almost certain to result in increased income from this source. The ideal vehicle for such a campaign is

THE ATLANTIC ELECTRIC TRUCK

—the perfect result of many months of design and development by one of the most prominent engineers in this line.

Atlantic Trucks are built in capacities of 1, 2, 3½ and 5 tons, equipped with Exide lead or Edison batteries. Write for specifications and prices.

Atlantic Vehicle Co.
Mecca Bldg.
48th ST. and B'WAY, NEW YORK
Factory: Newark, N. J.

ATLANTIC VEHICLE CO

CENTRAL GEORGIA POWER COMPANY.
Macon, Ga., Dec. 23, 1911.

Mr. P. G. Gossler,
A. B. Leach & Co., 149 Broadway, New York, N. Y.

Dear Mr. Gossler:—Your letter of the 19th inst. at hand asking for information in regard to details of the action of Pyrene on 66,000-volt arc, which was tried out in actual service on Friday, December 8th, in our Macon sub-station.

I have the logs of the Ocmulgee River Power House and the Macon sub-station before me, and it shows that at 9.47 A. M. bushing on No. 2 trunk line, 66,000-volt circuit breaker broke down, arcing over from various points on the bushing to the iron top of the circuit breaker tank.

The breaker did not open immediately and as the noise was so great that the operator could not use the telephone, he grabbed the can of Pyrene and applied it over the arc, immediately suppressing same.

From the appearance of the bushing, the second breakdown was direct from the bushing to the tank, and it was this second breakdown that caused the opening of the breaker at the power house. Before the operator at Macon could get in communication with the power house, current came back on again, as the practice is to test out after thirty seconds. The arc re-established itself along the outside of the bushing. He again used Pyrene on the arc, suppressing it and the current took its old path direct to the ground without arcing, thus knocking out the power house for the second time. By this time the power house had been notified of the trouble and under orders switched over on No. 1 circuit and three minutes after the interruption we were carrying Macon on an entirely different circuit.

The operator using the Pyrene stood upon the concrete floor, and as we have a grounded neutral system, he had practically 36,000 volts between his feet and the end of the stream of Pyrene, but he felt absolutely no effects, and is ready to use the Pyrene again if an emergency should arise.

Very truly yours,
(Signed) L. A. MAGRAW,
Chief Engineer.

An Emergency that Proved Pyrene Protection

—that proved the safety in using Pyrene on heavy arcs. The operator was exposed to no danger whatever.

Pyrene is the only extinguisher on earth that offers such *efficiency and safety* on electrical fires.

It is equally efficient on the most vicious fires in gasoline, carbide or any other material.

This power house has profited highly from their Pyrene installation.

Let us show you how *your* power plant will profit by Pyrene protection:

The Pyrene electrical booklet will explain the details. Write for it.

PYRENE MFG. CO., 1358 BROADWAY NEW YORK

Boston Chicago Baltimore Atlanta Pittsburgh Dayton
Washington Rochester Wilmington St. Louis Houston Philadelphia

Over 13,000,000 People Read About Electric Superiority Each Month
One Large Electric Truck Consumes More Current Than A Whole Block of Residences
The purchase and use of at least one Electric Vehicle is an important first step in any Central Station campaign
$90,000.00
Why Not Make Your Off-Peak Load Count
Why Not Reduce Your Delivery Cost?
Electric Trucks Solve the Delivery Problem
Why Not Cut the Cost of Delivering Beer?
Consider the Installation of Electric Trucks
The Royal Coach—Then and Now
Does Your Delivery Service Advertise Your Business?
Electric Delivery Wagons Will Save You Money
Why Feed Your Profit to Your Horses?
"We'll Go Right Over to the Bank —My Electric is at the Door"
"In That Case I Would Prescribe an Electric"
An Electric is the Car of Prestige
What Would You Think?
In the Fashion Centres of the World—
The Aristocratic Car—The Electric
When a Patient Says to You— "Doctor, What Machine Should I Buy?"
An Electric is the Car Desirable
Reduce Your Haulage Cost

Here Are Some of the Ads That Will Sell Electric Vehicles for Your Benefit

Over 13,000,000 people are reading these and similar advertisements every month, Mr. Central Station Manager. Over 13,000,000 readers of 36 magazines are being convinced that the Electric Vehicle—pleasure and commercial—is superior for many kinds of service. Lots of these people are right in your own territory—intelligent readers who can afford to buy Electric Vehicles. And they ***will*** buy Electric Vehicles if ***you*** give Electric Vehicles their due support.

You Know the Advantages of Electric Vehicles — Why Not Tell Others About Them?

You realize that every Electric Vehicle sold in your territory means additional revenue for you. You also know that the charging of Electric Vehicles means an elimination of costly off-peak periods. But if you, Mr. Central Station Manager, do not boost Electric Vehicles, you cannot expect our national publicity to bear fruit in your locality. If you use Electric Vehicles other concerns will follow your lead. They will use them if they see that you have faith in them. And you will really find Electric Delivery Service extremely serviceable and economical for your own purposes.

Our special plan for securing an Electric Vehicle charging business for Central Stations is at your disposal. It will show you how your Central Station can become part and parcel of our nation-wide campaign. Send for it today before you forget.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA

BOSTON NEW YORK: 124 W. 42nd St. [29] CHICAGO

LOOK

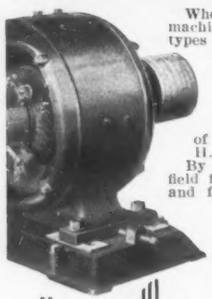
before you leap. We manufacture the only butt joint power transformers made in this country. There is no other type of transformer on the market to-day in which strength, high efficiency and good regulation of voltage are combined to so great a degree as in the Crocker–Wheeler core type, butt joint transformer. Time and again comparisons have been made between the performance of these and transformers of other makes, and the Crocker-Wheeler apparatus proved its superiority in every case. They are unusually strong, easy to repair and have very high efficiency. Why not install the most economical, durable and efficient transformer on the market?

Send for our Bulletin 154L.

CROCKER-WHEELER CO.

Ampere, N. J., Birmingham, Boston, Chicago, Cleveland, Denver, Detroit, Newark, New Haven, New York, Philadelphia, Pittsburg, San Francisco, Syracuse

WATSON MOTORS



Use Watson Motors.

Whether you are adopting motor drive to new machines or to old equipments, one of the many types and styles of Watson Motors is the right one for each particular case.

1082 Types and Sizes

of motors in capacities up to 15 H.P. D.C. and 45 H.P. A.C. are offered.
By concentrating our efforts in this small motor field for over 12 years we have perfected each part and feature. The Watson motor is a highly specialized product—it is not a by-product.
Our bulletins are yours for the asking.

Mechanical Appliance Co.
Milwaukee, Wisconsin

Lincoln Motors

impregnated with our special oil and waterproof varnish.

Operate Under Water

All windings both direct and alternating current are insulated in the same way.

LINCOLN ELECTRIC COMPANY
Kelley Ave. & 38th St. Cleveland, O
918 Monadnock Bldg., Chicago, Ill.

O. B. Transformer Compound

is *the* original oil-proof transformer compound. We recommend it as the only solid compound that is absolutely *oil-proof*, that can be successfully used for the impregnation of transformer coils designed to operate in oil.

It has remarkable dielectric strength, is waterproof, and absolutely unaffected by mineral oils.

Write for our booklet, "Insulating Specialties."

STANDARD VARNISH WORKS
New York Chicago London
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COMMONWEALTH EDISON CO.

REPAIR SHOPS

32 N. MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS.

CORRESPONDENCE SOLICITED

Wagner Power Transformers

The Power Transformers built by the Wagner Electric Manufacturing Company are backed by a reputat on for correct design, perfect construction and unequaled service. The Wagner Company constructed in 1896 the first 10,000-volt and in 1898 the first 40,000-volt equipment. During their progress in transformer building they have not only paid special attention to the large and important features, but have made a careful study of all the many minor details. This policy has enabled them to place at your disposal Power Transformers that are correctly made and whose several operating characteristics are so perfectly balanced that their service performance is unapproachable. Wagner Bulletin No. 99 just issued, deals with the subject of Power Transformers in a way that is of interest to every engineer. Your copy is waiting for you.

Wagner Electric Manufacturing Company, Saint Louis

LOTS OF TROUBLE SAVED

Belts, shafts, clutches, levers, all eliminated by use of

INTER-POLE MOTORS

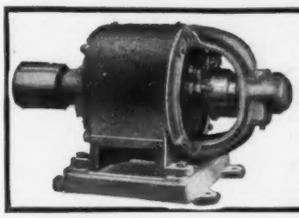
—to say nothing of the wide speed range always at your command.

The same controller that varies the speed will reverse the motor instantly. No sparking at any load.

Write for bulletins.

Electro Dynamic Co.
Bayonne, N. J.

Arcade Bldg., Philadelphia, Pa. 200 Ninth St., Pittsburg. Peoples Gas Bldg., Chicago.



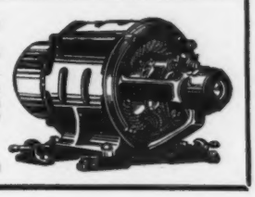
Bell High Efficiency Single Phase Motors
meet all requirements

Large stock carried throughout the country for immediate shipment.

Bell Electric Motor Co. (Licensed)
30 Church St., N. Y. Factory, Garwood, N. J.

The "Keep-A-Running" Qualities of Richmond Polyphase Motors

make them the very best alternating-current motors on the market to-day. Bulletin No. 14 goes into detail—write for a copy.



Richmond Electric Co.
Richmond, Virginia (2)

OUR MULTI-SPEED ELECTRIC MOTORS

are of the MULTI-POLAR form, from 5 H.P. up

ESTABLISHED 1875

We call them MULTI-SPEED because speed changes are not made by steps, but an absolutely unbroken range is furnished between the highest and lowest points—in other words, every imaginable speed is given within these limits.

They will carry full load at all speeds within their range without sparking, with an efficiency practically as high at one speed as another. These results are arrived at without the use of rheostats or controllers. Let us mail you further details.

STOW MFG. CO., Binghamton, N. Y.

General European Agents:
SELIG, SONENTHAL & CO., Queen Victoria St., London, Eng.

Drills 10 Times Faster Than by Hand!

800 to 2,000 blows per minute

Phillips' Spring Hammer

For Drilling Holes in Stone, Concrete, Brick, Tile, Conduit, Etc.

Absolutely indispensable for electrical workers and mechanics. Eliminates the strain and drudgery of drilling by hand and does the work in one minute that ordinarily requires ten times as long by manual methods.

Strikes 800 to 2,000 powerful hammer blows per minute. All you do is turn the crank. The spring does the work. Makes round and straight hole ⅜ inch to 1½ inches in diameter. Perfectly true to size. Made with extensions for ceiling and floor drilling. Strong and simple in construction. Nothing to get out of order. Compact, easily transported.

Sold at a price that will enable every electrical worker and mechanic to have one in his kit.

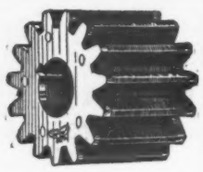
Write for Bulletin W and Price List.

ORR & LOCKETT HARDWARE Co Established 1872

15-17 W. Randolph St.
CHICAGO, ILL.

Noiseless Pinions

for motor and other high speed drives
See our large advertisement in first and third issues of the month.



The New Process Raw Hide Co.
500 Plum St., Syracuse, N. Y.

TROLLEYS

MARIS BROS.,
PHILADELPHIA

When Reactance Voltage Is High

and other influences prevent good commutation, use

MORGANITE BRUSHES

and stop the trouble. They have low contact-resistance on the edge where current enters, and high contact-resistance on the edge where it leaves, thus facilitating sparkless collection of current.

If you have brush troubles, send us data on your machine, and we will send you sample Morganite Brushes.

THE MORGAN CRUCIBLE CO., LTD.
114 Liberty Street, New York City

LEWIS-ROTH CO., Denckla Bldg., Philadelphia, Pa.
INDIANAPOLIS BRASS CO., Indianapolis, Ind. 1

APOLLO

SPECIAL ELECTRICAL SHEETS

Of Silicon Alloy Steel, Patented. Highest grade Electrical Sheets manufactured for transformers, dynamos and motors; insuring minimum heating, maximum capacity, non-aging. Other standard sheets are American Armature, U. S. Electrical, and Pole Face. Write for full information.

AMERICAN SHEET AND TIN PLATE COMPANY,
PITTSBURGH

AMERICAN SHEET & TIN PLATE CO. APOLLO SPECIAL ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

Special
Blanking, Trimming, Piercing & Forming
DIE WORK
Solicited
The Columbus Die, Tool & Machine Company
Columbus, Ohio

COMMUTATOR INSURANCE

THAT'S WHAT WE OFFER, FOR THERE'S NO FRICTION OR WEAR WITH THESE FIBRE GRAPHITE BRUSHES.

BEING 50 PER CENT. PURE GRAPHITE INSURES LOW RESISTANCE, NO SPARKING UNDER VARYING LOAD, LONGER WEAR AND NO GREASING.

HOLMES FIBRE-GRAPHITE Mfg. Co.
GERMANTOWN, PHILADELPHIA, PA.

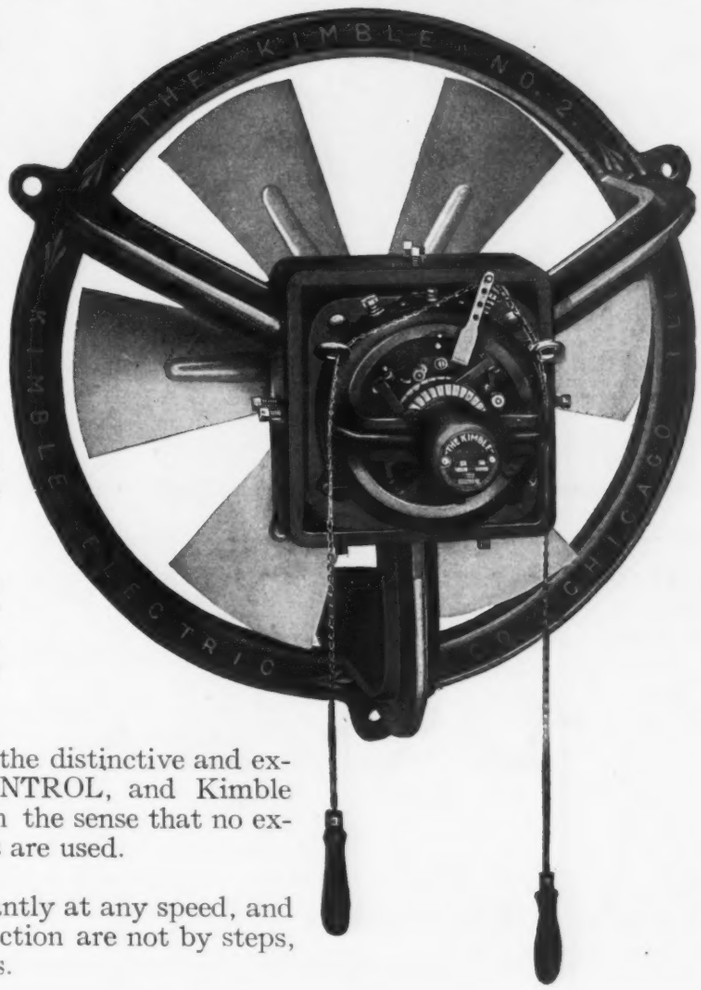
High Efficiency at Low Speed

A Distinctive Electrical Achievement as Embodied in

KIMBLE MOTORS

Single Phase, Variable Speed, Alternating Current

Easy On the Line



Kimble Motors do not disturb the voltage regulation, because of their low starting current.

The big 36-inch Kimble, straight-blade ventilating fan, with a 1½ H. P. Kimble Motor, moving 17,300 cubic feet of air per minute, starts on four amperes, runs full speed (550 R. P. M.) on 8 amperes, and reverses from full speed forward to full speed in the opposite direction on 9 amperes.

Such a fan and motor can safely be connected to your lighting line. Would you permit an ordinary 1½ H. P. motor on your lighting circuit?

All this is accomplished by the distinctive and exclusive Kimble method of CONTROL, and Kimble Motor control is self-control, in the sense that no external or supplementary devices are used.

Kimble Motors reverse instantly at any speed, and speed variations in either direction are not by steps, but by imperceptible gradations.

Reducing speed on Kimble Motors cuts current consumption correspondingly.

KIMBLE A. C. MOTORS are pecularly adapted to ventilating fans and to operating printing presses or other machines in which the load is fairly constant, and in which the ability to vary speeds or to reverse is of practical value.

Send for the Kimble Catalog—a book that reveals new and important possibilities in alternating current.

KIMBLE ELECTRIC COMPANY

1127 Washington Boulevard **CHICAGO**

Century

SINGLE PHASE MOTORS

are built to give constant, uninterrupted service. Every part is strong enough to withstand much more than could reasonably be expected of a motor of the rated capacity.

They are all equipped with interchangeable voltage connections (standard being 104-208 volts). An ordinary knife switch is all that is necessary to start them. They are self-starting under full load.

¼ to 40 horsepower—25 to 140 cycles.

CENTURY ELECTRIC CO.

NEW YORK OFFICE: 30 Church St.

19th and Olive Sts., St. LOUIS, MO.

TRIUMPH

Three-Wire Generators

Have safely carried ***50 per cent unbalancing*** without heating or sparking, and with a voltage regulation ***within 3 per cent.*** Such performance has never been equalled. These results are due to the excellent generator design and the use of a ***separate oil immersed*** balancing transformer. Triumph 3-wire generator installations are open for inspection at any time, and supported statements of their operation can be obtained from the owners.

Write Us

The Triumph Electric Co.

Cincinnati :-: :-: **Ohio**

Branches in sixteen principal cities

BRUSH COST PER K.W. HOUR CAN BE REDUCED

and actual trial on your own dynamos and motors will prove that

"Le Carbone" Brushes

will do it. They cause least possible wear on commutators, and effectively prevent flat spots and high mica

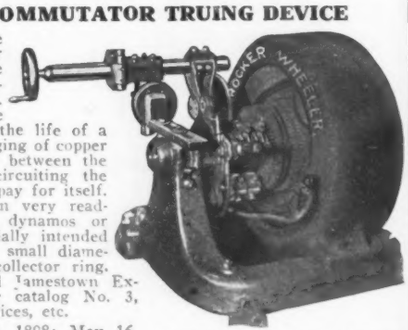
W. J. Jeandron

174 FULTON STREET NEW YORK

4

JORDAN COMMUTATOR TRUING DEVICE

This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short-circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award Jamestown Exposition. Write for catalog No. 3, with list of users, prices, etc.



Front View of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

Patented April 26, 1898; May 16, 1905; Sept. 6, 1910, and Jan 24, 1911. Other patents pending.

JORDAN BROTHERS, Inc., 74 Beekman Street, N. Y. City

High-Grade Carbon Brushes

The heads of a thousand dynamo rooms state positively over official signatures that LE VALLEY VITAE CARBON BRUSHES

Actually save their first cost again and again;

Saves time, labor and annoyance;

Save commutators, keeping them unscratched and glossy;

Save shut-down losses and repair bills;

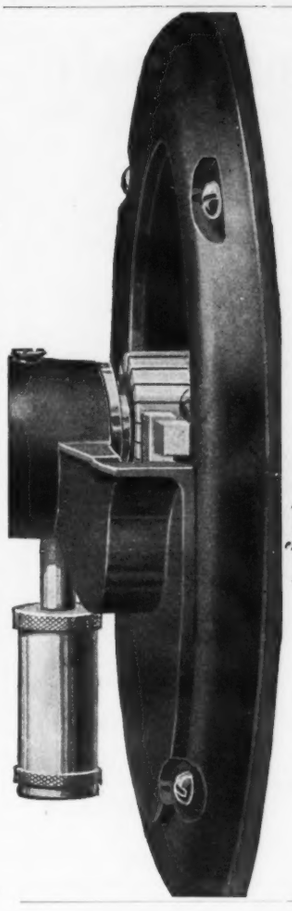
Save and make reputations for men and machinery;

Are in fact the one absolutely proven, generally admitted high-grade Carbon Brush, worthy of complete dependence and exclusive use in all places under all circumstances.

Le Valley Vitae Carbon Brush Co.

4123 Park Ave., New York City

Catalogs and Testimonials on Application



Special Motors for Special Machinery

We have a most complete list of special frames applicable to many kinds of machine driving which we do not list with our regular lines.

We want you to write our Board of Engineers of your power problem and let them give you free expert advice about the kind and number of motors necessary for your particular machines. This incurs no obligation on your part. Write to-day.

Robbins & Myers "STANDARD" Motors

1/30 to 15 H.P.

The Robbins & Myers Co.
Springfield, Ohio

BRANCHES
New York Chicago Boston
Philadelphia St. Louis Cleveland
Atlanta Rochester

We also manufacture the famous line of "Standard" Electric Fans for all purposes—for either direct or alternating current.

Extreme Precision

Rigid Mounting

Inter-changeable Parts

Silent Action

NORMA BALL BEARINGS

Small Extra Light Series

The standard bearings for magnetos, small dynamos, motors, speed indicators, and all small light running machines requiring high speeds.

The bearing celebrated by its wide and exclusive use by many renowned builders of high speed machines demanding true and silent running.

THE NORMA COMPANY OF AMERICA
20-22-24 VESEY STREET, NEW YORK, N. Y.

ROTHMOTORS

are applicable to any kind of service and give better service at lower cost.

They are designed for hard work and to fulfill all requirements.

BLOWERS
GRINDERS
POLISHERS

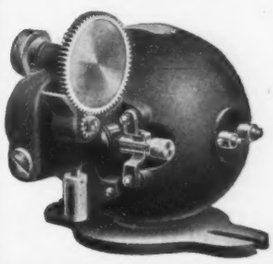
New York, 243 Canal St.
Pittsburgh, 1415 Keenan Bldg.
Cincinnati, 126 W. 2d St.
San Francisco, Monadnock Bldg.

ROTH BROS. & CO.
1400 W. Adams St.
CHICAGO

When the worm turns

inside of a gear filled with the proper grease as it does in the

Eck Worm-Geared Motors



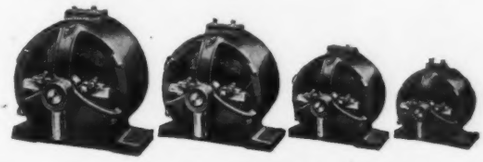
you get silent, efficient operation and an ideal machine for very slow speeds—just the thing for office accessories, such as adding machines, duplicators, etc., or advertising novelties such as working models, rotating display shelves, etc. 1/32 to 1/6 H.P. The subject is covered in the Eck Book Bulletin No. 44.

ECK DYNAMO & MOTOR CO.
BELLEVILLE, N. J. 1

These Are the "Biggest" Little Motors

on the market to-day. Little in size, but big in efficiency, dependability, workmanship and quality of material

Complete data on request.



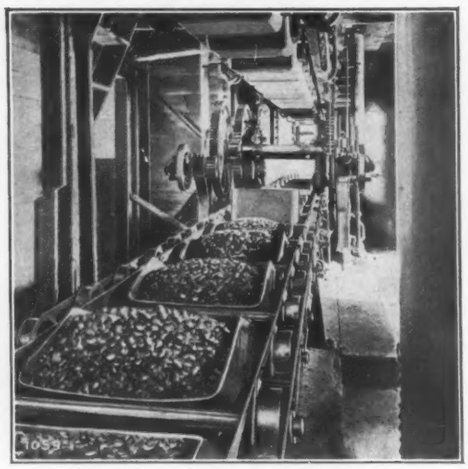
The Peerless Electric Co.
Factory and Main Office
Warren, Ohio 4

RELIANCE ADJUSTABLE SPEED MOTOR

No electrical controller is needed with this motor. The speed changes are obtained by a simple mechanical method which consists in shifting the motor armature. An unlimited number of running speeds are obtained over ranges as great as 1 to 10.

Our Folder 10E tells in detail about the advantages of Reliance Motors. Ask us to send a copy—it will interest you.

RELIANCE ELECTRIC & ENGINEERING CO.
1046 IVANHOE RD · CLEVELAND, O.



No. 1059.

The Lower Run of a Hunt Standard Conveyor Showing How Evenly the Buckets are Filled. The Bucket Standing Vertically is Dumping the Coal.

Ultimate Economy demands the Hunt Noiseless Conveyor

Operation is practical at any vertical angle and with twists to horizontal angles that with other designs would require *two* or *more* machines. Even under the severest of these conditions, material wear has never occurred in our driving mechanism, although some installations have seen *twenty-five years of service.*

Such performance is possible only through the splendid materials and workmanship which our product embodies, and the use of our patented pawl driver to abolish cumulative effects of wear at the links.

Forward movement of a Hunt Conveyor is accomplished by the pressure of pawls against studs in the chain so arranged that, whether the pawls and studs are lubricated or not, no destructive wear is possible at this point. The intermediate gears can be run entirely enclosed and in oil bath, so that the wear here is next to nothing.

Conveying machinery has been our specialty for the 40 long years during which we have been the recognized leaders in our lines. Our engineers have designed, installed and supervised the operation of so many conveyors that our free advice and co-operation will prove valuable on any coal and ash handling proposition.

The cost of a Hunt Conveyor installation can be closely estimated in advance and we are ready to refer you to abundant performance records to prove the low upkeep expense. Tell us your conditions and ask for Bulletin *D*42.

Established 1872

C. W. HUNT CO.

Manufacturers of "Industrial" Cable and Automatic Railways, Electric Locomotives; Conveying and Hoisting Machinery, "Stevedore" Transmission and Hoisting Rope

Main Office: WEST NEW BRIGHTON, NEW YORK

New York City, 45 Broadway
Chicago, 1616 Fisher Bldg.
San Francisco, Monadnock Bldg.
Washington, D.C., Evans Bldg.

Haste Without Waste!

NO WASTED TIME—
NO WASTED MONEY—
NO WASTED MATERIAL—

Where Geometric Adjustable Collapsing Taps Are Used

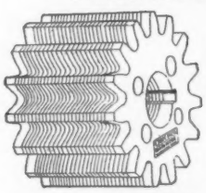
They give rapid production of accurate work.

May be fitted for use on Drill Press, Screw Machine or Turret Lathe.
GEOMETRIC TAPS collapse their Chasers automatically at the end of the cut, and no reverse motion is required to back them out.
Let us send you our Collapsing Tap Booklet, telling of their many advantages.

The Geometric Tool Company
NEW HAVEN, CONN.

3

How to Reduce Friction Vibration, Wear and Noise



is explained in our book on rawhide gearing in which the good points of

CHICAGO Rawhide Gears and Pinions

are pointed out.

THE BOOK AND SAMPLES FREE

The Chicago Rawhide Mfg. Co.
75-77 Ohio Street, CHICAGO, ILL.
492 Atlantic Ave., BOSTON, MASS.

FOR THREADING FIXTURES

electroliers, or any other sort of brass goods, use

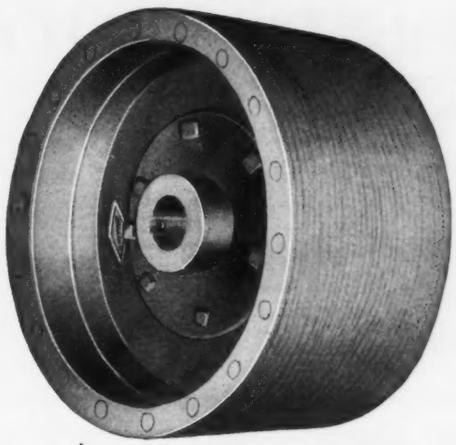
CARPENTER'S Adjustable Dies and Adjustable Stocks

—they cut clean, straight threads without the use of collets.

The Carpenter Catalog tells how and why. Write for it.

TRADE MARK C Registered

The J. M. Carpenter Tap & Die Co., Pawtucket, R. I. 6



It's Hardly Probable

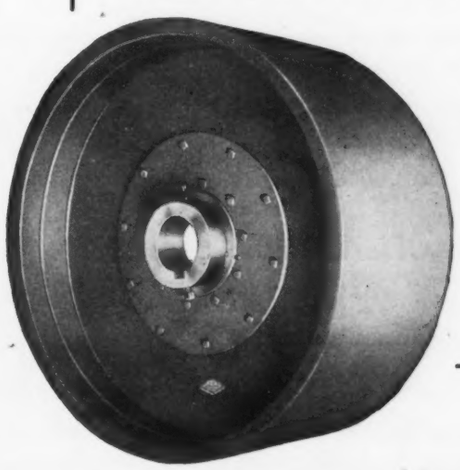
That the foremost electrical engineers and manufacturers would use Rockwood Paper Pulleys if they didn't possess real merit.

You Would Profit Immensely if You'd Only Follow the Dictates of Their Experience

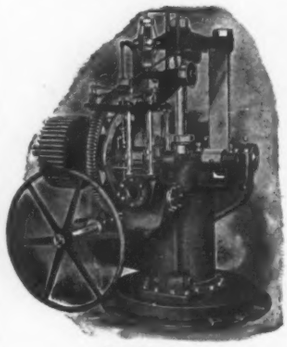
ROCKWOOD PAPER PULLEYS

are sold on the basis of proven merits. Our sales records show that.

We would like to number you one of our satisfied customers. Our files are full of engineering data and testimonials covering the adaptation of our pulleys to varied lines of work. If you are interested in any particular or special feature of belt driving, we would be glad to be of assistance to you.



The Rockwood Mfg. Co.
INDIANAPOLIS, INDIANA. U. S. A.



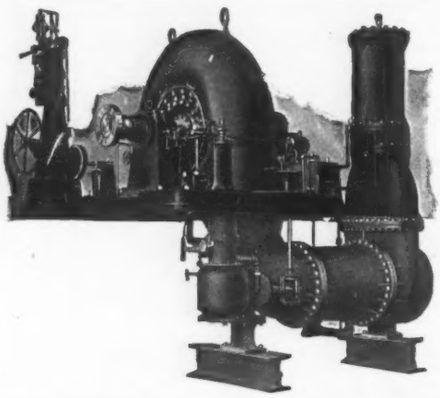
N. 14 Governor.
60,000 ft. lb. capacity.

FIRST OF ALL—RELIABILITY

The production of every one of our standard governors is the result of long continued, painstaking labor and conscientious care on the part of our employees. Our machines are governing many million horse-power of water wheels throughout the world.

Write us if you have difficult problems to solve

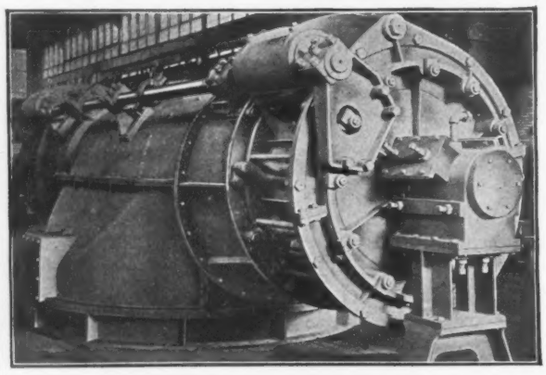
THE LOMBARD GOVERNOR CO.
ASHLAND, MASS.



HYDRAULIC TURBINES

ENGRAVING REPRESENTS
One of Three Units
Each
1760 Horse Power, 720 R. P. M., 280 Ft. Head
Furnished
Mohawk Hydro Electric Co., Ephrata, N. Y.
Turbines designed to meet all requirements for heads from 5 to 600 feet
WRITE FOR BULLETINS

S. MORGAN SMITH CO., York, Pa.
BRANCH OFFICES:
176 Federal Street, Boston, Mass. 644 American Trust Building, Chicago, Ill.

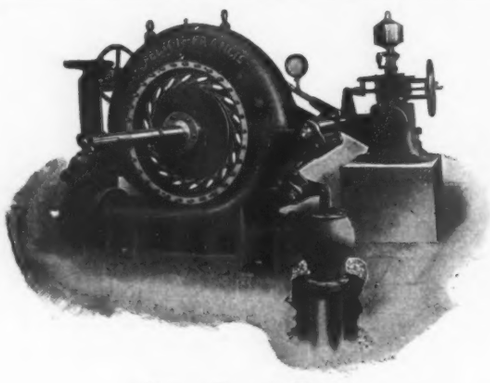


Samson Hydraulic Turbines

3000 Horse Power

This illustrates one of two units installed for the Virginia Passenger & Power Co., Richmond, Va. Each unit consists of SAMSON horizontal shaft turbines direct connected to generator. Head of water 25 feet, total capacity 3000 H. P. We would like the opportunity of bidding on your requirements in the way of turbines as we are fully prepared to furnish the latest and best design of turbine work. Shall we send you a catalog?

JAMES LEFFEL & CO.
308 Lagonda Street, Springfield, Ohio, U. S. A.
3



Pelton Francis Turbine

HYDRAULIC TURBINES

Of Any Capacity Built By

The Pelton Water Wheel Co.

91 West Street NEW YORK CITY ADDRESSES 2231 Harrison St., SAN FRANCISCO, CAL.

Where price is secondary to efficiency, speed regulation and continuous operation, then request *our estimates.*
4

WE HAVE INCREASED

Our Governor Department So That We Can Make Shipments of

The Improved Governor

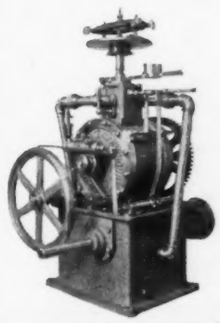
For Water Wheels *in*

TWO WEEKS From Receipt of Order. Governor to Be Installed On **A SIXTY DAY TRIAL**

HOLYOKE MACHINE CO., WORCESTER, MASS.

2

The Dickerson Automatic Governor



"A GOVERNOR THAT GOVERNS"

We guarantee the Dickerson Oil Pressure Water Wheel Governor to control any standard make of water wheel.

It is the most simple, most compact, occupies the least floor space, and is the lightest oil pressure Governor made for the foot pounds produced.

It gives the closest regulation, is the easiest installed, and requires the least care to keep it in continuous operation.

If you have any governor troubles or wish to avoid them write to

BURT & YATES, General Agents

306 Scott Building, Salt Lake City, Utah

TRUMP TURBINES

All styles and designs built to suit your location. Send at once for our illustrated catalog.

THE TRUMP MFG. COMPANY

Columbia & Greenmount Aves., Springfield, Ohio

ATWOOD

Valves and Fittings

All Sizes For All Purposes

Complete Piping Systems

Pittsburgh Valve Foundry And Construction Co., Pittsburgh, Pa.

WATER WHEEL GOVERNORS

Reliable—on the job—every day and minute—because made right. Close regulation for wheels of every make and size—any kind of load—any head. Fully guaranteed.

GOVERNOR DEPARTMENT, Troy

LUDLOW VALVE MANUFACTURING CO., New York

Green Chain Grate Stokers

For Water Tube and Tubular Boilers

GREEN ENGINEERING CO.

1330 Steger Bldg. Chicago, Ill.

Catalogue "G"—Green Chain Grate Stoker.
Catalogue No. 8—GECO Pneumatic Ash Handling Systems
send on application.

A Governor that Responds Quickly and Accurately to Load Variations

ALL SIZES

—

SPECIAL DESIGNS

The WOODWARD Oil-Pressure Water-Wheel GOVERNOR

Response to load variations appears practically simultaneous with the movement of the ammeter needle.

The gate action is swift but without shock. This governor is sensitive to a speed change of less than half of 1 per cent. There are many other good points. Bulletin L tells about them.

Write for a copy.

We also build a complete line of mechanical governors

WOODWARD GOVERNOR CO.

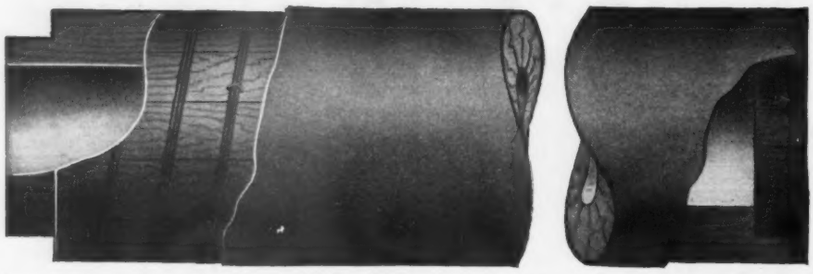
42 Years in the Business

202 Mill Street Rockford, Ill., U. S. A.

4

Central Power or Electric Lighting Plants Convert Waste Steam into Profit Through "MICHIGAN" Steam Pipe Casings!

SELL YOUR WASTE HEAT



SAVE YOUR HEAT ENERGY

A Tin Lined Wood Casing for Insulating Underground Steam Pipes which is composed of the Most Efficient Non-Conductive Materials Known

THE MICHIGAN PIPE CO. ABSOLUTELY WATERPROOF **BAY CITY, MICH.**

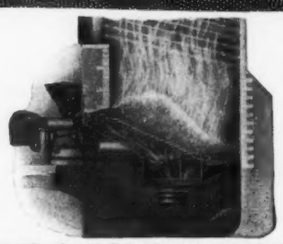
An Autobiography — Chapter 1

My Early Life—From birth I've been sturdy because I have a cast-iron constitution and my build is such that it keeps out all cold air germs.

I certainly do like work and never tire under any load as gravity always helps me along. I never get excited—I move slowly, yet with irresistible force. I'm scientific, too, and always give just the right amount of air with the coal.

TAYLOR

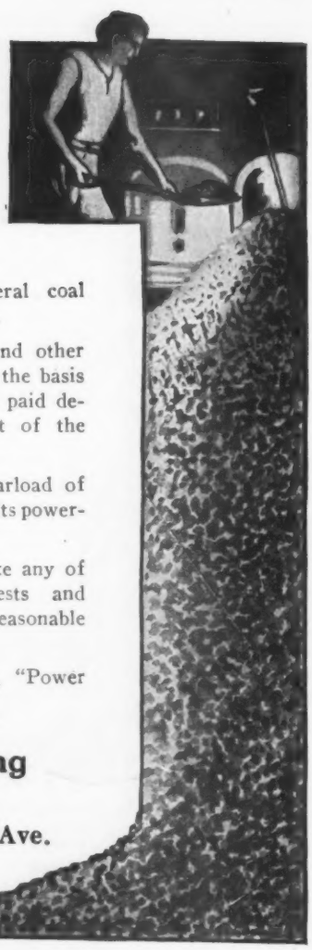
Now you've guessed that my name is although some call me "Gravity-Underfeed."



THE TAYLOR STOKER FIRE

Published by AMERICAN ENGINEERING CO. Philadelphia.

Buy Coal on the Basis of Its Heating Value



Like every other mineral coal varies widely in quality.

Ores of silver, copper and other metals are purchased on the basis of an analysis—the price paid depending upon the result of the assay.

The price paid for a carload of coal should depend upon its power-producing ability.

We are prepared to make any of the customary coal tests and analyses at very reasonable charges.

Write for our Booklet, "Power from Coal."

Electrical Testing Laboratories

80th St. and East End Ave.

New York

You avoid the necessity of another boiler house!

When your pumping station and factory are far apart install one of the many types of electrically driven

Alberger Centrifugal Pumps

and eliminate complicated piping. High efficiency Centrifugal Volute and Turbine Pumps for all practical combinations of head and quantity.

Write us for Catalogue

Alberger Pump and Condenser Co.

140 CEDAR STREET, NEW YORK

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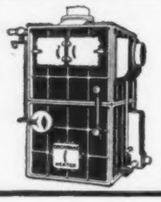
Bruce-Macbeth Gas Engines

Send for catalog.

THE BRUCE-MACBETH ENGINE CO., 2122 Center St., N.W. Cleveland



COCHRANE

Feed Water Heaters and Purifiers
Feed Water Heaters and Receivers
Steam and Oil Separators
Sorge-Cochrane Hot Process System of Water Softening
Multiport Safety Exhaust Outlet Valves for Back Pressure and for Vacuum Service

Harrison Safety Boiler Works

3159 N. 17th St., Philadelphia, Pa.

True Stories of Advertising Successes

By a Manufacturer of Electric Heaters

It may be of interest to you to know that we have recently received orders for export to South Africa and also to Brazil, which we are able to trace directly to the advertising we are doing in your Journal. ***The profit received from our export business alone in 1911 more than paid the expense of our advertising in your paper.***

By a Manufacturer of Graphic Meters

We are getting excellent results from the advertising in your paper, and we doubt if during the coming year we shall use space in any other electrical paper except yours.

Electrical World
239 W. 39th St., New York

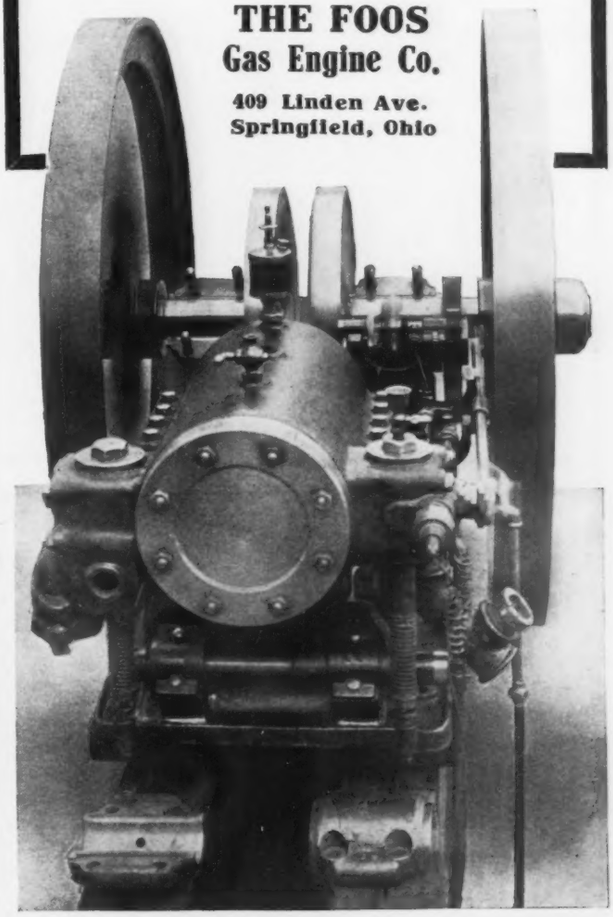
THE FOOS

SINGLE CYLINDER HORIZONTAL GAS and GASOLINE ENGINES

Are so perfectly counterbalanced that they will operate with both caps removed from the main bearings. The scientific design of the centerline disc counterbalance system contributes to a great extent to the smooth running qualities and close regulation which make the Foos Horizontal so desirable for isolated plants up to 75 hp. Tests have also been made which prove the ability of these engines to operate at a speed 40 per cent above the normal rating, resting on polished steel rollers. A photograph of such a test in the Foos Catalog proves that the engine was entirely free from vibration although it could be rolled freely back and forth by hand.

A copy of this Bulletin (F-94) will be sent on request for information concerning the great reliability and economy of Foos Electric Plants.

THE FOOS Gas Engine Co.
409 Linden Ave.
Springfield, Ohio



It's Time to Choose

between a comparatively small income next summer earned by current-sales alone, and the full-sized income earned by current sales plus the operation of a

Carbondale
ICE MACHINE

in making "By-Product Ice." The sales problem solves itself, because local ice-dealers are always willing to pay a good price for the product. The income from the sale of ice is apt to be larger than from your lighting load.

Ask for our booklet, "By-Product Ice."

Carbondale Machine Company
Carbondale, Pa.

Eastern Office
50 CHURCH STREET
New York

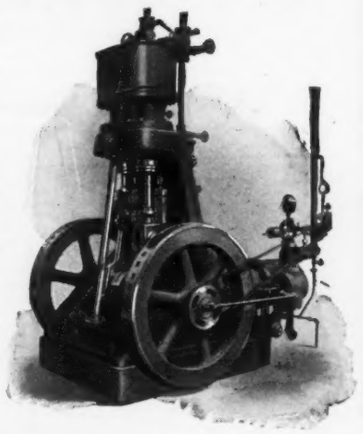
Western Office
1013 MANHATTAN BLDG.
Chicago

WHEN LIGHTING BILLS GO DOWN

you won't need to send your solicitors out to hunt up more load if you have a

YORK ICE-MAKING PLANT

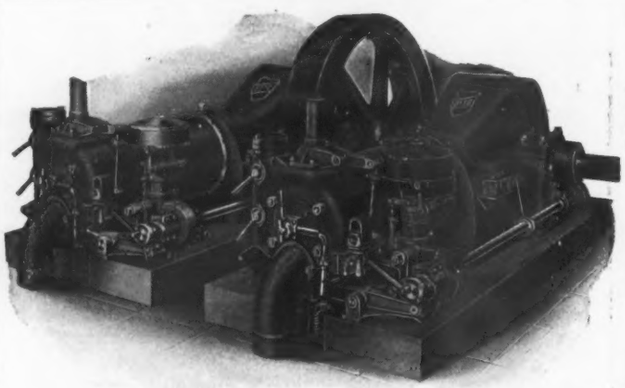
It is the most profitable "off-peak" load you can have—and, being right in your own plant, it can be so controlled as to offer no interference with your regular load.



The York Bulletins describe a wide variety of plants suitable for the needs of large or small stations. Write for them today.

YORK MANUFACTURING CO. **York, Pa.**
Largest Ice Machine Manufacturers in the World

General Western Offices: Monadnock Block, Chicago
BRANCHES in Boston, New York, Philadelphia, Pittsburg, Atlanta, Cincinnati, St. Louis, Houston, Los Angeles, Oakland, Seattle



The Otto Twins

are introduced to you as the latest type of Otto Gas Engine construction. These throttling governor engines are built in single cylinders in the following sizes:

50-60-80-100-110-125-150 HP.
IN TWIN CYLINDERS:
100-120-160-200-220-250-300 HP.

Otto Bulletin No. 10 contains much information of practical value to every manufacturer, mechanical or electrical engineer. You should have the last word in gas engine practice.

If interested in smaller units request copy of Bulletins 3 and 7—all free upon request.

THE OTTO GAS ENGINE WORKS
3207 Walnut Street, PHILADELPHIA, PA.

We have not had to turn down our commutators in ten years.

We have used Dixon's Graphite Brushes during this period and as a result commutators are in perfect condition.

Booklet 47-M free on request

JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

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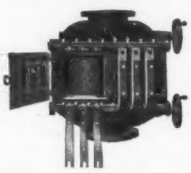


TUBE CLEANERS
TWIN STRAINERS
POWER ACCESSORIES

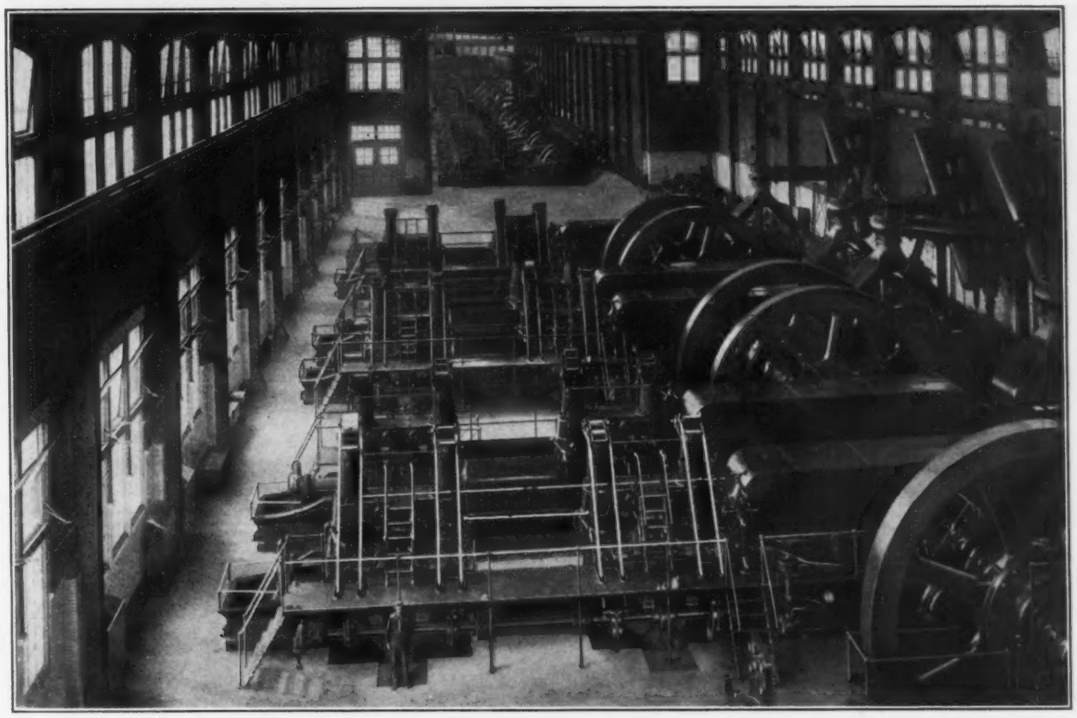
Elliott Company
6901 Susquehanna St., Pittsburg, Pa.

An Advertiser in Our Classified Column Writes:—

We want to congratulate you on the results of our one time adv. which brought forth intelligent replies from all over the country and England.

BETHLEHEM STEEL COMPANY

GAS ENGINES AND PUMPING ENGINES



IN the above station there are nine Bethlehem Steel Gas Engines and four additional units are being installed.

Over 60,000 brake horse power in operation and under construction.

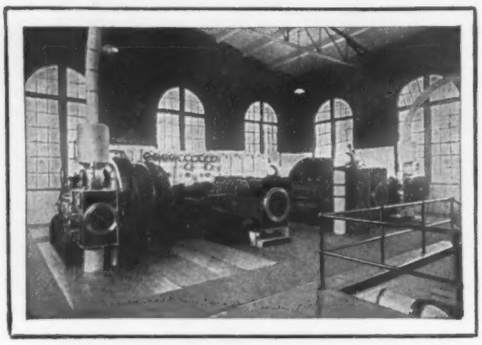
Bethlehem Steel Gas Engines are built in sizes from 800 to 5000 Brake Horse Power for operating on all kinds of gas and all kinds of service, representing the highest development and latest achievement in gas engines.

Bethlehem Steel Pumping Engines in service and under construction embrace vertical triple expansion high duty pumping engines for Atlantic City, Baltimore, Chicago, Detroit, Erie and Pittsburgh.

POWER DEPARTMENT

BETHLEHEM STEEL COMPANY

SOUTH BETHLEHEM, PENNA.



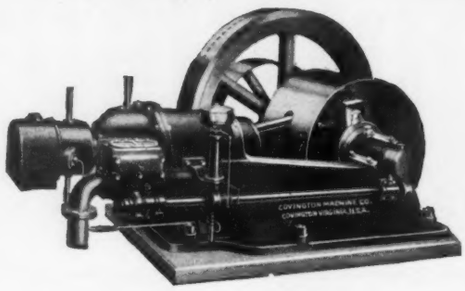
Ball Engines

BALL Engines in the Corliss and Single Valve automatic types represent a high degree of perfection in the design and in the quality of workmanship and materials.

Our works are modern, well lighted and equipped, our organization is very complete, and our workmen are careful and skillful.

We have had a long and successful experience in the manufacture of steam engines for electric power service, and our products are worthy of the consideration of buyers who appreciate the value of good design and construction in engines for electric power service.

BALL ENGINE COMPANY
ERIE, PA.



Reduce the Overhead Charges

on your product by reducing your power expenses—do it by installing

COVINGTON OIL ENGINES

ASK YOUR CONSULTING ENGINEER

Fuel-Saving—With fuel oil at 3 cents per gallon, the cost for each 100 H.P. hours will not exceed 39 cents with Type A, and 32 cents with Type B.

Upkeep-Saving—Repairs or replacements are unusual with these engines when properly operated. This is due to the low pressures, slow speeds and low temperatures employed.

Attendance-Saving—Skilled mechanics are not required. Any employee can quickly learn the method of operation, and one-fourth of his time ordinarily will be enough to care for the engine properly.

Compare the above with your present expense of operating a producer-gas or steam plant—and remember that Covington Oil Engines involve no operating expense whatever, except when actually running—stand-by losses are eliminated.

COVINGTON MACHINE CO.
SALES OFFICE: 88 WALL ST., NEW YORK
WORKS: COVINGTON, VA.

McINTOSH & SEYMOUR CO.

Auburn, N. Y.

VERTICAL, HORIZONTAL, **BELTED, DIRECT COUPLED,**

Steam Engines

New York:	Philadelphia:	San Francisco	Boston:
McIntosh & Seymour Co.	McIntosh & Seymour Co.	Charles C. Moore & Co.	J. A. Grant & Co.
50 Church St.	1218 Chestnut St.	99 First St.	Tremont Bldg.

Chicago: McIntosh & Seymour Co., 1641 Monadnock Block

If You Are Burning More Coal and Your Boilers Are Producing Less Power

Look for scale in your boilers. Nine chances in ten they are coated with scale—and there is where the trouble lies. 1/16-inch of scale robs you of 13% of the heating value of your fuel.

Dearborn Treatment will keep your boilers free from scale—it is the recognized standard with steam plant operators.

Send gallon sample of your feed water for analysis. We will furnish special Treatment to suit your conditions.

DEARBORN DRUG & CHEMICAL WORKS, McCormick Bldg., Chicago

BRANCHES
Atlanta
Boston
Chicago
Cincinnati
Cleveland
Denver
Havana, Cuba
Los Angeles

THE BABCOCK & WILCOX COMPANY

85 Liberty Street, New York

WATER TUBE BOILERS

Steam Superheaters Mechanical Stokers

BRANCHES
New Orleans
Philadelphia
Pittsburgh
Portland, Ore.
Salt Lake City
San Francisco
Seattle

Are You Making All the Money

that you ought of your light or power plant? If you look closely into the construction of

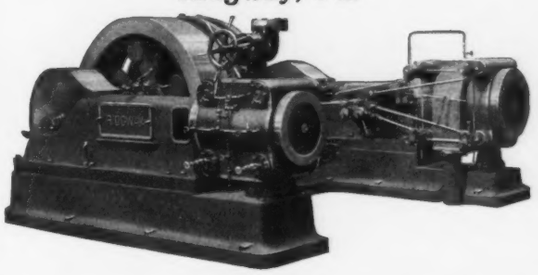
Ridgway Units

and watch them in daily service, you will note certain features that mean money savings.

For instance—maximum economy, compactness, stability, unusual accessibility of all parts, improved lubrication, ease of adjustment for wear, etc.

Other details are described in our bulletins —yours upon request.

Ridgway Dynamo & Engine Co.
Ridgway, Pa.



BLAKE-KNOWLES
OPEN FEED WATER HEATERS
Increase Boiler Efficiency

BLAKE-KNOWLES Heaters successfully combine in one apparatus the functions of *Feed Water Heater—Oil Separator—Purifier and Automatic Receiver.* Necessary to the economical operation of any steam plant. Correspondence invited.

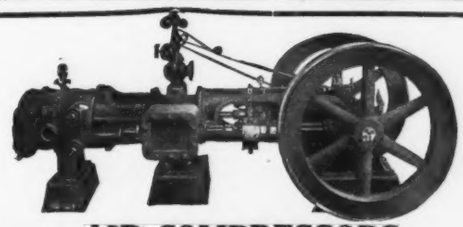
Write for Bulletin B. K. 847-38

The Blake & Knowles Steam Pump Works
WORKS: EAST CAMBRIDGE, MASS. New York Office: 115 Broadway

BRANCH OFFICES IN ALL PRINCIPAL CITIES

B 157.2

The Laidlaw-Dunn-Gordon Co.



AIR COMPRESSORS
The Laidlaw-Dunn-Gordon line of Air Compressors includes apparatus especially designed for every service. *A few of the small sizes are described in Bulletin L547-38.*
General Office: 115 Broadway, N. Y. Works: Cincinnati, O.
L 122.1

ANOTHER ADVANTAGE
of the
Loomis-Pettibone Gas Generating System

Absolutely no tar generated, consequently no clogging of pipes nor sticking of engine valves.

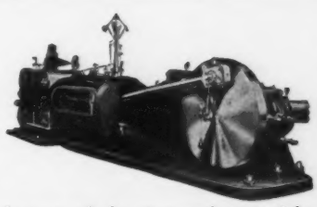
A score more advantages are given in Bulletin PM 102-38, which describes the best system of producing Gas for Power.

POWER & MINING MACHINERY CO.
WORKS: CUDAHY, WIS. New York Office: 115 Broadway

M186.1

MURRAY CORLISS ENGINES

Engine on exhibition in the Bourse, Philadelphia



are of the latest design and best workmanship and excel in regulation, efficiency and economy.

MURRAY BOILERS
whether water-tube, tubular or marine, are always of the highest grade.

MURRAY IRON WORKS CO., Burlington, Iowa
Incorporated, Feb. 1st, 1870.

DEMING PUMPS
FOR OPERATION BY ELECTRIC MOTOR, GAS OR GASOLINE ENGINE, OR BELT DRIVEN FROM LINE SHAFT. CONTINUOUS FLOW FROM DISCHARGE.

Tell Us the Conditions

The Deming Company
Salem :: :: Ohio
Hand and Power Pumps for All Uses
HENION & HUBBELL :: Chicago
HARRIS PUMP & SUPPLY CO. Pittsburg
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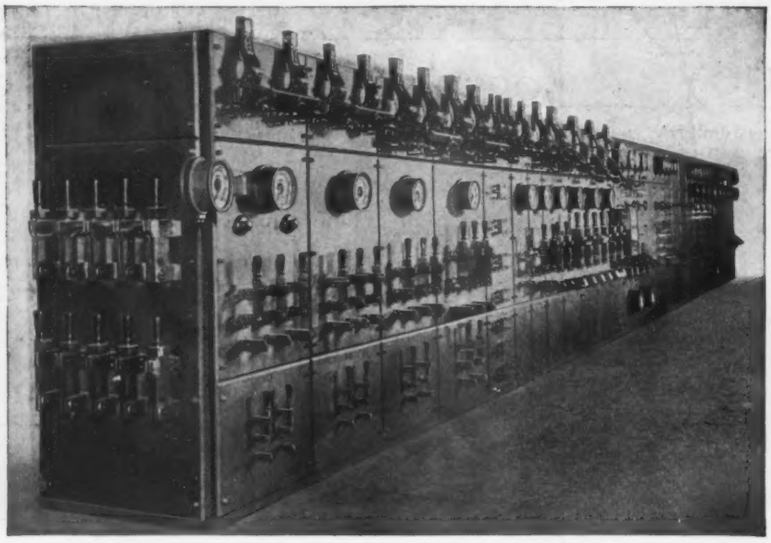

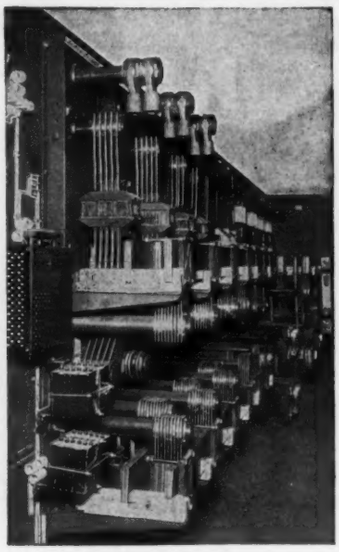

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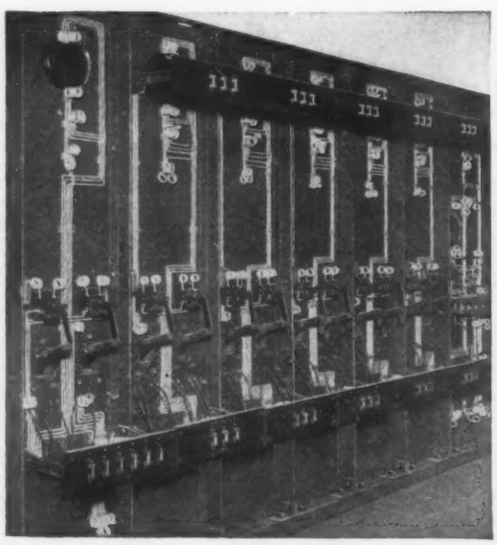

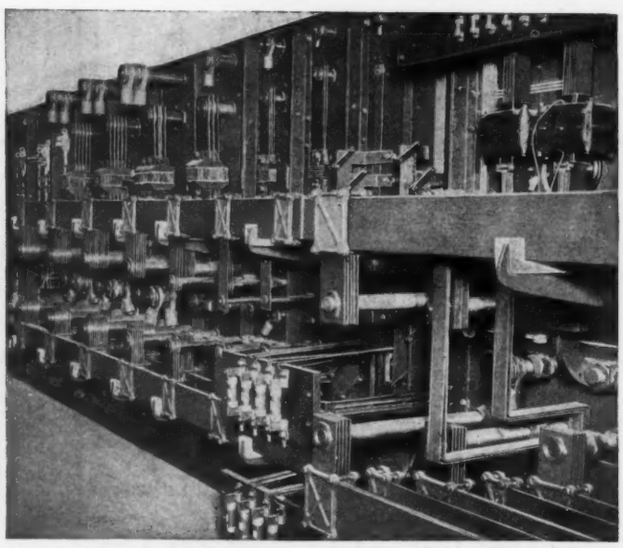

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Alphabetical Index and Classified Directory second page following reading

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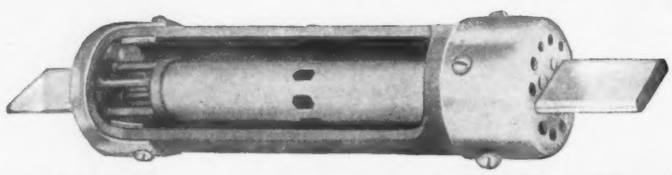

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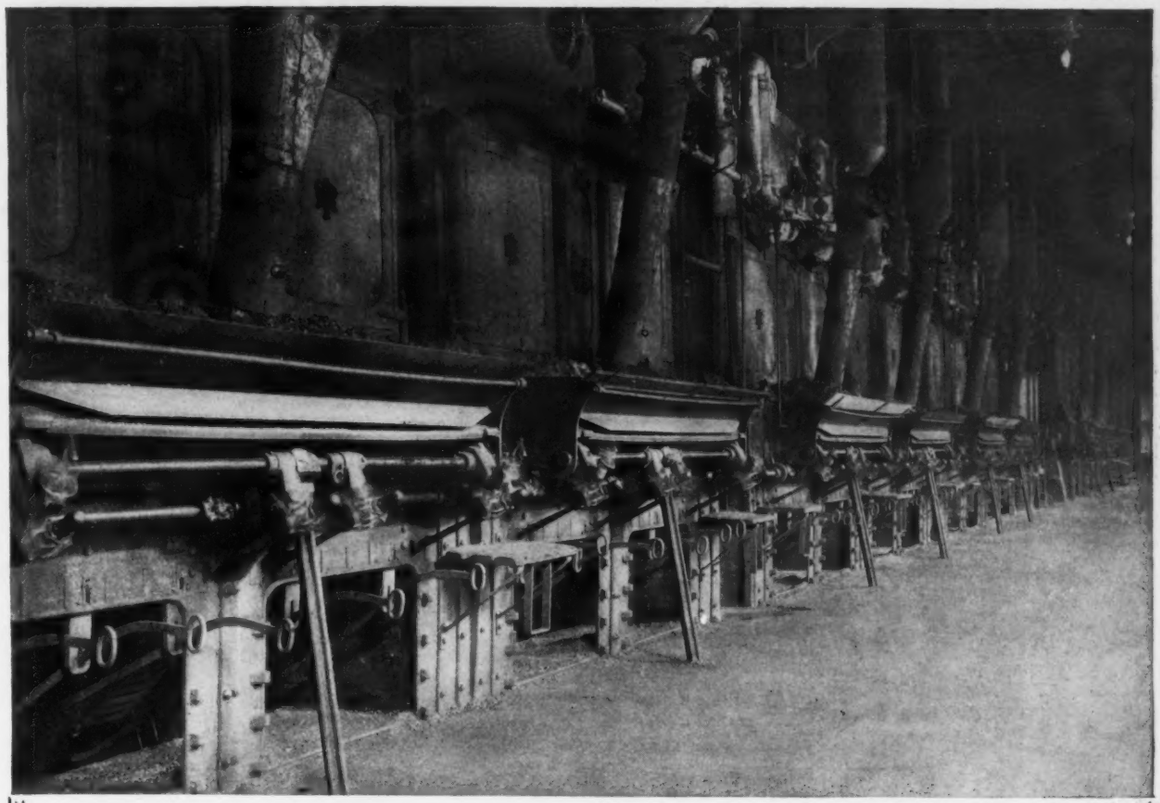

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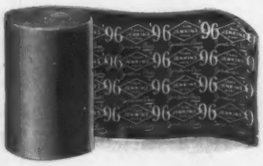

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